3.3 Aging Management of Auxiliary Systems

This section of the SER documents the staff's review of the applicant's AMR results for the auxiliary systems components and component groups of the:

- Auxiliary and Fuel Handling Building Ventilation Systems
- Auxiliary Steam System
- Circulating Water System
- Closed Cycle Cooling Water System
- Containment Isolation System
- Control Building Ventilation System
- Cranes and Hoists
- Diesel Generator Building Ventilation System
- Emergency Diesel Generators and Auxiliary Systems
- Fire Protection System
- Fuel Handling and Fuel Storage System
- Fuel Oil System
- Hydrogen Monitoring
- Instrument and Control Air System
- Intake Screen and Pump House Ventilation System
- Intermediate Building Ventilation System
- Liquid and Gas Sampling System
- Miscellaneous Floor and Equipment Drains System
- Open Cycle Cooling Water System
- Radiation Monitoring System
- Radwaste System
- Service Building Chilled Water System
- Spent Fuel Cooling System
- Station Blackout and UPS Diesel Generator Systems
- Water Treatment & Distribution System

3.3.1 Summary of Technical Information in the Application

LRA Section 3.3 provides AMR results for the auxiliary systems components and component groups. LRA Table 3.3.1, "Summary of Aging Management Programs for Auxiliary Systems," is a summary comparison of the applicant's AMRs with those evaluated in the GALL Report for the auxiliary systems components and component groups.

The applicant's AMRs evaluated and incorporated applicable plant-specific and industry operating experience in the determination of AERMs. The plant-specific evaluation included condition reports and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.3.2 Staff Evaluation

The staff reviewed LRA Section 3.3 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging for auxiliary system components within the scope of license renewal and subject to an AMR, will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff conducted an onsite audit of AMPs to ensure the applicant's claim that certain AMPs were consistent with the GALL Report. The purpose of this audit was to examine the applicant's AMPs and related documentation and to verify the applicant's claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff's evaluations of the AMPs are documented in SER Section 3.0.3.

The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Section 3.3.2.1 and 3.3.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff's evaluation are discussed in SER Section 3.3.2.3.

For components which the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's operating experience to verify the applicant's claims.

Table 3.3-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.3 and addressed in the GALL Report.

Table 3.3-1 Staff Evaluation for Auxiliary System Components in the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel cranes - structural girders exposed to air - indoor uncontrolled (external) (3.3.1-1)	Cumulative fatigue damage	TLAA to be evaluated for structural girders of cranes. See the SRP-LR, Section 4.7 for generic guidance for meeting the requirements of 10 CFR 54.21(c)(1).	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.3.2.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel and stainless steel piping, piping components, piping elements, and heat exchanger components exposed to air - indoor uncontrolled, treated borated water or treated water (3.3.1-2)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.3.2.2.1)
Stainless steel heat exchanger tubes exposed to treated water (3.3.1-3)	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes	Water Chemistry One-Time Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.2)
Stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution > 60°C (> 140°F) (3.3.1-4)	Cracking due to stress corrosion cracking	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.3)
Stainless steel and stainless clad steel heat exchanger components exposed to treated water > 60°C (> 140°F) (3.3.1-5)	Cracking due to stress corrosion cracking	A plant specific aging management program is to be evaluated.	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.3)
Stainless steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust (3.3.1-6)	Cracking due to stress corrosion cracking	A plant specific aging management program is to be evaluated.	Yes	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL Report (See SER Section 3.3.2.2.3)
Stainless steel non-regenerative heat exchanger components exposed to treated borated water > 60°C (> 140°F) (3.3.1-7)	Cracking due to stress corrosion cracking and cyclic loading	Water Chemistry and a plant-specific verification program. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.4)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel regenerative heat exchanger components exposed to treated borated water > 60°C (> 140°F) (3.3.1-8)	Cracking due to stress corrosion cracking and cyclic loading	Water Chemistry and a plant-specific verification program. The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. A plant specific aging management program is to be evaluated.	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.4)
Stainless steel high-pressure pump casing in PWR chemical and volume control system (3.3.1-9)	Cracking due to stress corrosion cracking and cyclic loading	Water Chemistry and a plant-specific verification program. The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. A plant specific aging management program is to be evaluated.	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.4)
High-strength steel closure bolting exposed to air with steam or water leakage. (3.3.1-10)	Cracking due to stress corrosion cracking, cyclic loading	Bolting Integrity. The AMP is to be augmented by appropriate inspection to detect cracking if the bolts are not otherwise replaced during maintenance.	Yes	Not Applicable	Not Applicable to TMI-1 (See SER Section 3.3.2.2.4)
Elastomer seals and components exposed to air - indoor uncontrolled (internal/external) (3.3.1-11)	Hardening and loss of strength due to elastomer degradation	A plant-specific aging management program is to be evaluated.	Yes	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components External Surface Monitoring	Consistent with GALL Report (See SER Section 3.3.2.2.5)
Elastomer lining exposed to treated water or treated borated water (3.3.1-12)	Hardening and loss of strength due to elastomer degradation	A plant-specific aging management program is to be evaluated.	Yes	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL Report (See SER Section 3.3.2.2.5)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Boral®, boron steel spent fuel storage racks neutron-absorbing sheets exposed to treated water or treated borated water (3.3.1-13)	Reduction of neutron-absorbing capacity and loss of material due to general corrosion	A plant-specific aging management program is to be evaluated.	Yes	Water Chemistry	Consistent with GALL Report (See SER Section 3.3.2.2.6)
Steel piping, piping component, and piping elements exposed to lubricating oil (3.3.1-14)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.7)
Steel reactor coolant pump oil collection system piping, tubing, and valve bodies exposed to lubricating oil (3.3.1-15)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.7)
Steel reactor coolant pump oil collection system tank exposed to lubricating oil (3.3.1-16)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection to evaluate the thickness of the lower portion of the tank	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.7)
Steel piping, piping components, and piping elements exposed to treated water (3.3.1-17)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.7)
Stainless steel and steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust (3.3.1-18)	Loss of material/general (steel only), pitting and crevice corrosion	A plant specific aging management program is to be evaluated.	Yes	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL Report (See SER Section 3.3.2.2.7)
Steel (with or without coating or wrapping) piping, piping components, and piping elements exposed to soil (3.3.1-19)	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	Yes	Buried Piping and Tanks Inspection program	Consistent with GALL Report (See SER Section 3.3.2.2.8)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping, piping components, piping elements, and tanks exposed to fuel oil (3.3.1-20)	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling	Fuel Oil Chemistry and One-Time Inspection	Yes	Fuel Oil Chemistry One-Time Inspection and Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL (See SER Section 3.3.2.2.9)
Steel heat exchanger components exposed to lubricating oil (3.3.1-21)	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis and One-Time Inspection	Not Consistent with GALL Report (See SER Section 3.3.2.2.9)
Steel with elastomer lining or stainless steel cladding piping, piping components, and piping elements exposed to treated water and treated borated water (3.3.1-22)	Loss of material due to pitting and crevice corrosion (only for steel after lining/cladding degradation)	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.10)
Stainless steel and steel with stainless steel cladding heat exchanger components exposed to treated water (3.3.1-23)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.10)
Stainless steel and aluminum piping, piping components, and piping elements exposed to treated water (3.3.1-24)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.10)
Copper alloy HVAC piping, piping components, piping elements exposed to condensation (external) (3.3.1-25)	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components and External Surfaces Monitoring Program	Consistent with GALL Report (See SER Section 3.3.2.2.10)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Copper alloy piping, piping components, and piping elements exposed to lubricating oil (3.3.1-26)	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis and One-Time Inspection Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL Report (See SER Section 3.3.2.2.10)
Stainless steel HVAC ducting and aluminum HVAC piping, piping components and piping elements exposed to condensation (3.3.1-27)	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL Report (See SER Section 3.3.2.2.10)
Copper alloy fire protection piping, piping components, and piping elements exposed to condensation (internal) (3.3.1-28)	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Fire Protection Fire Water System Compressed Air Monitoring One Time Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.10)
Stainless steel piping, piping components, and piping elements exposed to soil (3.3.1-29)	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes	Buried Piping and Tanks Inspection program	Consistent with GALL Report (See SER Section 3.3.2.2.10.)
Stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution (3.3.1-30)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.10)
Copper alloy piping, piping components, and piping elements exposed to treated water (3.3.1-31)	Loss of material due to pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.11)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel, aluminum and copper alloy piping, piping components, and piping elements exposed to fuel oil (3.3.1-32)	Loss of material due to pitting, crevice, and microbiologically -influenced corrosion	Fuel Oil Chemistry and One-Time Inspection	Yes	Fuel Oil Chemistry One-Time Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.12)
Stainless steel piping, piping components, and piping elements exposed to lubricating oil (3.3.1-33)	Loss of material due to pitting, crevice, and microbiologically -influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components External Surfaces Monitoring Program Lubricating Oil Analysis One-Time Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.12)
Elastomer seals and components exposed to air - indoor uncontrolled (internal or external) (3.3.1-34)	Loss of material due to wear	A plant-specific aging management program is to be evaluated.	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.13)
Steel with stainless steel cladding pump casing exposed to treated borated water (3.3.1-35)	Loss of material due to cladding breach	A plant-specific aging management program is to be evaluated. Reference NRC IN 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.2.14)
Boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated water (3.3.1-36)	Reduction of neutron-absorbing capacity due to boraflex degradation	Boraflex Monitoring	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel piping, piping components, and piping elements exposed to treated water > 60°C (> 140°F) (3.3.1-37)	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	BWR Reactor Water Cleanup System	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Stainless steel piping, piping components, and piping elements exposed to treated water > 60°C (> 140°F) (3.3.1-38)	Cracking due to stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Stainless steel BWR spent fuel storage racks exposed to treated water > 60°C (> 140°F) (3.3.1-39)	Cracking due to stress corrosion cracking	Water Chemistry	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Steel tanks in diesel fuel oil system exposed to air - outdoor (external) (3.3.1-40)	Loss of material due to general, pitting, and crevice corrosion	Aboveground Steel Tanks	No	Aboveground Steel Tanks	Consistent with GALL Report
High-strength steel closure bolting exposed to air with steam or water leakage (3.3.1-41)	Cracking due to cyclic loading, stress corrosion cracking	Bolting Integrity	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Steel closure bolting exposed to air with steam or water leakage (3.3.1-42)	Loss of material due to general corrosion	Bolting Integrity	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Steel bolting and closure bolting exposed to air - indoor uncontrolled (external) or air - outdoor (external) (3.3.1-43)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	External Surfaces Monitoring Program Bolting Integrity Program	Consistent with GALL Report (See SER Section 3.3.2.1.2)
Steel compressed air system closure bolting exposed to condensation (3.3.1-44)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel closure bolting exposed to air - indoor uncontrolled (external) (3.3.1-45)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	Bolting Integrity Program Inspection of Overhead Heavy Load and Light Load Handling Systems	Consistent with GALL Report (See SER Section 3.3.2.3.7)
Stainless steel and stainless clad steel piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water > 60°C (> 140°F) (3.3.1-46)	Cracking due to stress corrosion cracking	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System	Consistent with GALL Report
Steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to closed cycle cooling water (3.3.1-47)	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System	Consistent with GALL Report
Steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to closed cycle cooling water (3.3.1-48)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System	Consistent with GALL Report (See SER Section 3.3.2.1.15)
Stainless steel; steel with stainless steel cladding heat exchanger components exposed to closed cycle cooling water (3.3.1-49)	Loss of material due to microbiologically -influenced corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Stainless steel piping, piping components, and piping elements exposed to closed cycle cooling water (3.3.1-50)	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System	Consistent with GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Copper alloy piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water (3.3.1-51)	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System	Consistent with GALL Report (See SER Section 3.3.2.1.16)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed cycle cooling water (3.3.1-52)	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	Closed-Cycle Cooling Water System	Consistent with GALL Report
Steel compressed air system piping, piping components, and piping elements exposed to condensation (internal) (3.3.1-53)	Loss of material due to general and pitting corrosion	Compressed Air Monitoring	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Stainless steel compressed air system piping, piping components, and piping elements exposed to internal condensation (3.3.1-54)	Loss of material due to pitting and crevice corrosion	Compressed Air Monitoring	No	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Fire Protection Fire Water System Compressed Air Monitoring	Consistent with GALL Report (See SER Section 3.3.2.1.3)
Steel ducting closure bolting exposed to air - indoor uncontrolled (external) (3.3.1-55)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring	Consistent with GALL Report
Steel HVAC ducting and components external surfaces exposed to air - indoor uncontrolled (external) (3.3.1-56)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring	Consistent with GALL Report
Steel piping and components external surfaces exposed to air - indoor uncontrolled (external) (3.3.1-57)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring	Consistent with GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel external surfaces exposed to air - indoor uncontrolled (external), air - outdoor (external), and condensation (external) (3.3.1-58)	Loss of material due to general corrosion	External Surfaces Monitoring	No	Fire Protection External Surface Monitoring	Consistent with GALL Report (See SER Section 3.3.2.1.4)
Steel heat exchanger components exposed to air - indoor uncontrolled (external) or air -outdoor (external) (3.3.1-59)	Loss of material due to general, pitting, and crevice corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to air - outdoor (external) (3.3.1-60)	Loss of material due to general, pitting, and crevice corrosion	External Surfaces Monitoring	No	Fire Protection External Surfaces Monitoring Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Consistent with GALL Report (See SER Sections 3.3.2.1.5, 3.3.2.3.7)
Elastomer fire barrier penetration seals exposed to air - outdoor or air - indoor uncontrolled (3.3.1-61)	Increased hardness, shrinkage and loss of strength due to weathering	Fire Protection	No	Fire Protection	Consistent with GALL Report
Aluminum piping, piping components, and piping elements exposed to raw water (3.3.1-62)	Loss of material due to pitting and crevice corrosion	Fire Protection	No	Fire Water System Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.3.2.1.6)
Steel fire rated doors exposed to air - outdoor or air - indoor uncontrolled (3.3.1-63)	Loss of material due to wear	Fire Protection	No	Fire Protection Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Consistent with GALL Report (See SER Section 3.3.2.3.7)
Steel piping, piping components, and piping elements exposed to fuel oil (3.3.1-64)	Loss of material due to general, pitting, and crevice corrosion	Fire Protection and Fuel Oil Chemistry	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Reinforced concrete structural fire barriers - walls, ceilings and floors exposed to air - indoor uncontrolled (3.3.1-65)	Concrete cracking and spalling due to aggressive chemical attack, and reaction with aggregates	Fire Protection and Structures Monitoring Program	No	Fire Protection Structures Monitoring Program	Consistent with GALL Report
Reinforced concrete structural fire barriers - walls, ceilings and floors exposed to air - outdoor (3.3.1-66)	Concrete cracking and spalling due to freeze thaw, aggressive chemical attack, and reaction with aggregates	Fire Protection and Structures Monitoring Program	No	Fire Protection Structures Monitoring Program	Consistent with GALL Report
Reinforced concrete structural fire barriers - walls, ceilings and floors exposed to air - outdoor or air - indoor uncontrolled (3.3.1-67)	Loss of material due to corrosion of embedded steel	Fire Protection and Structures Monitoring Program	No	Fire Protection Structures Monitoring Program	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to raw water (3.3.1-68)	Loss of material due to general, pitting, crevice, and microbiologically -influenced corrosion, and fouling	Fire Water System	No	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components and External Surfaces Monitoring Program (B.2.1.21) Fire Water System	Consistent with GALL Report (See SER Section 3.3.2.1.7)
Stainless steel piping, piping components, and piping elements exposed to raw water (3.3.1-69)	Loss of material due to pitting and crevice corrosion, and fouling	Fire Water System	No	Fire Water System	Consistent with GALL Report
Copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-70)	Loss of material due to pitting, crevice, and microbiologically -influenced corrosion, and fouling	Fire Water System	No	Fire Water System	Consistent with GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping, piping components, and piping elements exposed to moist air or condensation (internal) (3.3.1-71)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Fire Protection Compressed Air Monitoring Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL Report (See SER Section 3.3.2.1.8)
Steel HVAC ducting and components internal surfaces exposed to condensation (internal) (3.3.1-72)	Loss of material due to general, pitting, crevice, and (for drip pans and drain lines) microbiologically -influenced corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Compressed Air Monitoring Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL Report (See SER Section 3.3.2.1.9)
Steel crane structural girders in load handling system exposed to air - indoor uncontrolled (external) (3.3.1-73)	Loss of material due to general corrosion	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	No	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program	Consistent with GALL Report
Steel cranes - rails exposed to air - indoor uncontrolled (external) (3.3.1-74)	Loss of material due to Wear	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	No	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program	Consistent with GALL Report
Elastomer seals and components exposed to raw water (3.3.1-75)	Hardening and loss of strength due to elastomer degradation; loss of material due to erosion	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Steel piping, piping components, and piping elements (without lining/ coating or with degraded lining/coating) exposed to raw water (3.3.1-76)	Loss of material due to general, pitting, crevice, and microbiologically -influenced corrosion, fouling, and lining/coating degradation	Open-Cycle Cooling Water System	No	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Open Cycle Cooling Water System	Consistent with GALL Report (See SER Sections 3.3.2.1.10, 3.3.2.1.17)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel heat exchanger components exposed to raw water (3.3.1-77)	Loss of material due to general, pitting, crevice, galvanic, and microbiologically -influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Stainless steel, nickel alloy, and copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-78)	Loss of material due to pitting and crevice corrosion	Open-Cycle Cooling Water System	No	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Open-Cycle Cooling Water System	Consistent with GALL Report (See SER Section 3.3.2.1.11)
Stainless steel piping, piping components, and piping elements exposed to raw water (3.3.1-79)	Loss of material due to pitting and crevice corrosion, and fouling	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-80)	Loss of material due to pitting, crevice, and microbiologically -influenced corrosion	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Fire Water System	Consistent with GALL Report (See SER Section 3.3.2.1.12)
Copper alloy piping, piping components, and piping elements, exposed to raw water (3.3.1-81)	Loss of material due to pitting, crevice, and microbiologically -influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Open Cycle Cooling Water System	Consistent with GALL Report (See SER Section 3.3.2.1.13)
Copper alloy heat exchanger components exposed to raw water (3.3.1-82)	Loss of material due to pitting, crevice, galvanic, and microbiologically -influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System	Consistent with GALL Report (See SER Section 3.3.2.1.18)
Stainless steel and copper alloy heat exchanger tubes exposed to raw water (3.3.1-83)	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System	Consistent with GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Copper alloy > 15% Zn piping, piping components, piping elements, and heat exchanger components exposed to raw water, treated water, or closed cycle cooling water (3.3.1-84)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching	Consistent with GALL Report
Gray cast iron piping, piping components, and piping elements exposed to soil, raw water, treated water, or closed-cycle cooling water (3.3.1-85)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching	Consistent with GALL Report
Structural steel (new fuel storage rack assembly) exposed to air - indoor uncontrolled (external) (3.3.1-86)	Loss of material due to general, pitting, and crevice corrosion	Structures Monitoring Program	No	Fire Protection	Consistent with GALL Report (See SER Section 3.3.2.1.14)
Boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated borated water (3.3.1-87)	Reduction of neutron-absorbing capacity due to boraflex degradation	Boraflex Monitoring	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.3.2.1.1)
Aluminum and copper alloy > 15% Zn piping, piping components, and piping elements exposed to air with borated water leakage (3.3.1-88)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Boric Acid Corrosion	Consistent with GALL Report
Steel bolting and external surfaces exposed to air with borated water leakage (3.3.1-89)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Boric Acid Corrosion	Consistent with GALL Report
Stainless steel and steel with stainless steel cladding piping, piping components, piping elements, tanks, and fuel storage racks exposed to treated borated water > 60°C (> 140°F) (3.3.1-90)	Cracking due to stress corrosion cracking	Water Chemistry	No	Water Chemistry, or Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.19)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel and steel with stainless steel cladding piping, piping components, and piping elements exposed to treated borated water (3.3.1-91)	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	Water Chemistry, or Water Chemistry and One-Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.19)
Galvanized steel piping, piping components, and piping elements exposed to air - indoor uncontrolled (3.3.1-92)	None	None	No	None	Consistent with the GALL Report
Glass piping elements exposed to air, air - indoor uncontrolled (external), fuel oil, lubricating oil, raw water, treated water, and treated borated water (3.3.1-93)	None	None	No	None	Consistent with the GALL Report
Stainless steel and nickel alloy piping, piping components, and piping elements exposed to air - indoor uncontrolled (external) (3.3.1-94)	None	None	No	None	Consistent with the GALL Report
Steel and aluminum piping, piping components, and piping elements exposed to air - indoor controlled (external) (3.3.1-95)	None	None	No	None	Consistent with the GALL Report
Steel and stainless steel piping, piping components, and piping elements in concrete (3.3.1-96)	None	None	No	None	Consistent with the GALL Report
Steel, stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas (3.3.1-97)	None	None	No	None	Consistent with the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel, stainless steel, and copper alloy piping, piping components, and piping elements exposed to dried air (3.3.1-98)	None	None	No	None	Consistent with the GALL Report
Stainless steel and copper alloy < 15% Zn piping, *piping components, and* piping elements exposed to air with borated water leakage (3.3.1-99)	None	None	No	None	Consistent with the GALL Report

The staff's review of the auxiliary systems component groups followed several approaches. One approach, documented in SER Section 3.3.2.1, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.3.2.2, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.3.2.3, discusses the staff's review of AMR results for components the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the auxiliary systems components is documented in SER Section 3.0.3.

3.3.2.1 AMR Results That Are Consistent with the GALL Report

LRA Section 3.3.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the auxiliary systems components:

- Aboveground Steel Tanks
- Bolting Integrity
- Boric Acid Corrosion
- Buried Piping and Tanks Inspection
- Closed Cycle Cooling Water System
- Compressed Air Monitoring
- External Surfaces Monitoring
- Fire Protection
- Fire Water System

- Flow-Accelerated Corrosion
- Fuel Oil Chemistry
- Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
- Lubricating Oil Analysis
- One-Time Inspection
- Open Cycle Cooling Water System
- Selective Leaching of Materials
- Structures Monitoring Program
- TLAA
- Water Chemistry

LRA Tables 3.3.2-1 through 3.3.2-25 summarize AMRs for the auxiliary systems components and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant had claimed consistency and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item. The notes describe how the information in the tables aligns with the information in the GALL Report. The staff audited those AMRs with Notes A through E, which indicate how the AMR was consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff audited these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and confirmed that it had reviewed and accepted the identified exceptions to the GALL Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component under review. The staff audited these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component applied to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and confirmed whether the AMR line item of the different component was applicable to the component under review. The staff confirmed whether it had reviewed and accepted the exceptions to the GALL Report AMPs. It also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff audited these line items to verify consistency with the GALL Report and determined whether the identified AMP would manage the aging effect consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.
The staff did not repeat its review of the matters described in the GALL Report; however, it did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs. The staff's evaluation is discussed below.

The staff reviewed the LRA to confirm that the applicant: (a) provided a brief description of the system, components, materials, and environments; (b) stated that the applicable aging effects were reviewed and evaluated in the GALL Report; and (c) identified those aging effects for the auxiliary systems components that are subject to an AMR.

On the basis of its audit and review, the staff determines that, for AMRs not requiring further evaluation, as identified in LRA Table 3.3.1, the applicant's references to the GALL Report are acceptable and no further staff review is required.

3.3.2.1.1 ARM Results Identified as Not Applicable

Based on its initial review, the staff could not determine the specific reason why the applicant considered LRA Table 3.3.1, line items 41, 42, 44, 49, 53, 64, 75, 77, 79, and 87 to be not applicable. In RAI-AMR-GENERIC-1, dated October 16, 2008, the staff requested that the applicant provide additional information regarding these not applicable items so the staff could complete its evaluation.

In its response to the RAI dated October 30, 2008, the applicant stated that "Not Applicable" has been used when the component, material and environment combination does not exist in the identified GALL system grouping and also when the component, material and environment combination does exist but the LRA Table 3.x.1 item was not used because a different Table 3.x.1 item was selected to manage the identified aging effect/mechanism.

Based on its review, the staff finds the applicant's response to RAI-AMR-GENERIC-1 unacceptable because the applicant did not provide the specific reasons it used to consider the subject line items in LRA Table 3.1.1 not applicable and the staff could not complete its review.

In RAI-AMR-GENERIC-2, dated January 5, 2009, the staff requested that the applicant indicate for each of the LRA Table 3.x. 1 items where "not applicable" is listed in the "discussion" column, the specific reason why the item is considered not applicable to TMI-1. The staff also requested that if the component, material and environment does exist but the LRA Table 3.x.1 item was not used, that the applicant indicate what other 3.x.1 item was selected to manage the identified aging effect/mechanism.

In its response to the RAI dated January 12, 2009, the applicant provided a table identifying the specific reason(s) why a Table 3.x.1 item is not considered applicable to TMI-1.

Based on its review, the staff finds the applicant's response to RAI AMR-GENERIC-2 acceptable because the applicant provided the basis for LRA Table 3.x.1 line items identified as "not applicable." The staff's concern described in RAI AMR-GENERIC-2 is resolved.

LRA Table 3.3.1, line items 36 – 39, discusses the applicant's determination on GALL AMR line items that are applicable only to BWR-designed reactors. In the applicant AMR discussions for line items 36 – 39, no additional information is provided. The staff confirmed that AMR line items 36 – 39, in Table 1 of the GALL Report, Volume 1 are only applicable to BWR designed reactors, and that TMI-1 is a pressurized water reactor with a dry ambient containment. Based on this determination, the staff finds that AMR line items 36 – 39, in Table 1 of the GALL Report, Volume 1 are not applicable to TMI-1.

LRA Table 3.3.1, line item 41 addresses high strength steel closure bolting exposed to air with steam or water leakage. The GALL Report recommends the Bolting Integrity AMP to manage cracking due to cyclic loading, stress corrosion cracking in this component group. In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that this line item is not applicable because there is no high-strength steel closure bolting exposed to air with steam or water leakage in auxiliary systems. The staff reviewed LRA Sections 2.3.3 and 3.3 and confirmed that TMI-1 does not have support systems that are part of the auxiliary systems with-in the scope of license renewal that contain the high strength closure bolting fabricated from steel exposed to air with steam or water leakage. Based on its review of the LRA, the staff confirmed that there is no high-strength steel closure bolting exposed to air with steam or water leakage in auxiliary systems and, therefore, finds the applicant's determination acceptable.

LRA Table 3.3.1, line item 42 addresses steel closure bolting exposed to air with steam or water leakage. The GALL Report recommends the Bolting Integrity AMP to manage loss of material due to general corrosion in this component group. In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that this line item is not applicable because there is no steel closure bolting exposed to air with steam or water leakage in auxiliary systems. The staff reviewed LRA Sections 2.3.3 and 3.3 and confirmed that TMI-1 does not have support systems that are part of the auxiliary systems with-in the scope of license renewal that contain the closure bolting fabricated from steel exposed to air with steam or water leakage. Based on its review of the LRA, the staff confirmed that there is no steel closure bolting exposed to air with steam or water leakage in auxiliary systems and, therefore, finds the applicant's determination acceptable.

LRA Table 3.3.1, line item 44 addresses steel compressed air system closure bolting exposed to condensation. The GALL Report recommends the Bolting Integrity AMP to manage loss of material due to general, pitting, and crevice corrosion in this component group. In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that there is no steel compressed air system closure bolting exposed to condensation in auxiliary systems. The staff reviewed LRA

Sections 2.3.3 and 3.3 and confirmed that TMI-1 does not have support systems that are part of the auxiliary systems with-in the scope of license renewal that contain the compressed air system closure bolting fabricated from steel exposed to condensation. Based on its review of the LRA, the staff confirmed that there is no steel compressed air system closure bolting exposed to condensation in auxiliary systems and, therefore, finds the applicant's determination acceptable.

LRA Table 3.3.1, line item 49 addresses stainless steel; steel with stainless steel cladding heat exchanger components exposed to closed cycle cooling water. The GALL Report recommends the Closed Cycle Cooling Water System AMP to manage loss of material due to microbiologically-influenced corrosion. In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that this component, material, environment, and aging effect/mechanism combination does not exist in auxiliary systems. The applicant also stated that MIC is not predicted in closed cycle cooling water due to the lack of a MIC source. The staff reviewed LRA Sections 2.3.3 and 3.3 and confirmed that TMI-1 does not have support systems that are part of the auxiliary systems with-in the scope of license renewal that contain the heat exchanger components fabricated from stainless steel or steel with stainless steel cladding exposed to closed cycle cooling water. Based on its review of the LRA, the staff confirmed that this component, material, environment, and aging effect/mechanism combination does not exist in auxiliary systems and also that MIC is not predicted in closed cycle cooling water due to the lack of a MIC source. The staff finds the applicant's determination acceptable.

LRA Table 3.3.1, line item 53 addresses steel compressed air system piping, piping components, and piping elements exposed to condensation (internal). The GALL Report recommends the Compressed Air Monitoring AMP to manage loss of material due to general and pitting corrosion. In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that this component, material, and environment combination is addressed by Item 3.3.1-71 since Item 3.3.1-53 does not include crevice corrosion, which is predicted for TMI-1 for this component, material, and environment combination. The applicant further stated that as discussed in the "Discussion" column for Item 3.3.1-71 in LRA Table 3.3.1, the Compressed Air Monitoring AMP has been substituted for the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components AMP and that in this case, the Table 2 AMR line item was identified with an "E" Standard Note and a plant specific note stating: "The aging effects of carbon steel in an air/gas - wetted (internal) environment include loss of material due to general, pitting, and crevice corrosion. These aging effects/mechanisms are managed by the Compressed Air Monitoring program." Based on its review of the LRA, the staff confirmed that this component, material, and environment combination is addressed by item 3.3.1-71 since item 3.3.1-53 does not include crevice corrosion, which is predicted for this component, material, and environment combination. The staff also confirmed that the Compressed Air Monitoring AMP has been substituted for the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components AMP. The staff finds the applicant's determination acceptable.

LRA Table 3.3.1, line item 64 addresses steel piping, piping components, and piping elements exposed to fuel oil. The GALL Report recommends the Fire Protection and Fuel Oil Chemistry AMPs to manage loss of material due to general, pitting, and crevice corrosion. In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that it predicts the additional aging mechanisms of MIC and fouling for steel components in fuel oil and that this component, material, environment, and aging effect/mechanism combination is addressed by item 3.3.1-20. Based on its review of the LRA, the staff confirmed that the applicant predicts the additional aging mechanisms of MIC and fouling for steel components in fuel oil and that this component, material, environment, and aging effect/mechanism combination is addressed by item 3.3.1-20. The staff finds the applicant's determination acceptable.

LRA Table 3.3.1, line item 75 addresses elastomer seals and components exposed to raw water. The GALL Report recommends the Open Cycle Cooling Water System AMP to manage hardening and loss of strength due to elastomer degradation; loss of material due to erosion. In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that there are no elastomer seals and components exposed to raw water in auxiliary systems. The staff reviewed LRA Sections 2.3.3 and 3.3 and confirmed that TMI-1 does not have support systems that are part of the auxiliary systems with-in the scope of license renewal that contain the seals and components fabricated from elastomers exposed to raw water. Based on its review of the LRA, the staff confirmed that there are no elastomer seals and components exposed to raw water in auxiliary systems, and, therefore, the staff finds the applicant's determination acceptable.

LRA Table 3.3.1, line item 77 addresses steel heat exchanger components exposed to raw water. The GALL Report recommends the Open Cycle Cooling Water System AMP to manage loss of material due to pitting and crevice corrosion in this component group. In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that this component, material, environment, and aging effect combination is addressed by items 3.2.1-35, 3.3.1-68, and 3.3.1-76 since galvanic corrosion as identified in Item 3.3.1-77 does not apply to these heat exchanger components. The applicant also stated that the component, material, environment, and aging effect combination addressed by items 3.2.1-35 and 3.3.1-76 are managed by the Open-Cycle Cooling Water System AMP and that the raw water environment associated with floor and equipment drain systems and addressed by item 3.3.1-68 are managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components AMP since Open-Cycle Cooling Water System AMP activities do not address waste raw water. Based on its review of the LRA, the staff confirmed that this component, material, environment, and aging effect combination is addressed by items 3.2.1-35, 3.3.1-68, and 3.3.1-76 since galvanic corrosion as identified in item 3.3.1-77 does not apply to these heat exchanger components. The staff also confirmed that the component, material, environment, and aging effect combination addressed by items 3.2.1-35 and 3.3.1-76 are managed by the Open-Cycle Cooling Water System AMP and that the raw water environment associated with floor and equipment drain systems and addressed by item 3.3.1-68 are managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components AMP since Open-Cycle Cooling Water System AMP activities do not address waste raw waters. The staff finds the applicant's determination acceptable.

LRA Table 3.3.1, line item 79 addresses stainless steel piping, piping components, and piping elements exposed to raw water. The GALL Report recommends the Open Cycle Cooling Water System AMP to manage loss of material due to pitting and crevice corrosion, and fouling in this component group. In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that it predicts the additional aging mechanism of MIC for stainless steel components exposed to raw water and that this component, material, environment, and aging effect/mechanism combination is addressed by Items 3.2.1-38 and 3.4.1-33. The applicant also stated that circulating water system components in raw water are managed by the Open-Cycle Cooling Water System AMP and that components exposed to waste raw water environments are managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components AMP since the Open Cycle Cooling Water System AMP activities do not address waste raw water. Based on its review of the LRA, the staff confirmed that the applicant predicts the additional aging mechanism of MIC for stainless steel components exposed to raw water and that this component, material, environment, and aging effect/mechanism combination is addressed by Items 3.2.1-38 and 3.4.1-33. The staff also confirmed that circulating water system components in raw water are managed by the Open-Cycle Cooling Water System AMP and that components exposed to waste raw water environments are managed by the Inspection of Internal Surfaces in Miscellaneous Piping and

Ducting Components AMP since the Open Cycle Cooling Water System AMP activities do not address waste raw water. The staff finds the applicant's determination acceptable.

LRA Table 3.3.1, line item 87 addresses boraflex spent fuel storage racks neutron absorbing sheets exposed to treated borated water. The GALL Report recommends the Boraflex Monitoring AMP to manage reduction of neutron absorbing capacity due to boraflex degradation in this component group. In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that there are no boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated borated water in auxiliary systems and that the fuel storage racks are Boral® and are addressed by item 3.3.1-13. Based on its review of the LRA, the staff confirmed that there are no boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated borated water in auxiliary systems and that the fuel storage racks are Boral and are addressed by item 3.3.1-13. The staff finds the applicant's determination acceptable.

3.3.2.1.2 Loss Of Material Due To General, Pitting, And Crevice Corrosion

LRA Table 3.3.1, Item 3.3.1-43 addresses loss of material due to general, pitting and crevice corrosion for steel components with its external surfaces exposed to outdoor air in the auxiliary and fuel handling building ventilation system.

The LRA credits the External Surfaces Monitoring Program to manage this aging effect for steel piping, fittings and valve body components in an outdoor air (external) environment only. The GALL Report recommends GALL AMP XI.M18, "Bolting Integrity," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with GALL Report material, environment, and aging effect, but a different aging management program is credited.

The staff reviewed the applicant's External Surfaces Monitoring program and its evaluation is documented in SER Sections 3.0.3.2.16. The staff noted from its review that all but one AMR line item that the referenced line item 3.3.1-43 and credited the External Surfaces Monitoring Program are not bolting components with an intended function for mechanical closure. The staff further noted that the applicant referenced Item 3.3.1-43 of LRA Table 3.3.1 because there was not another applicable Table 1 line item in LRA Table 3.3.1 that corresponded to the same material, environment and aging effect combination. The staff confirmed that for the one AMR line item in this review that is a bolting component with an intended function for mechanical closure that was listed, the applicant also credited the Bolting Integrity Program for managing loss of material due to general, pitting and crevice corrosion, which is consistent with the GALL Report. The staff noted that the applicant took a conservative approach by crediting the GALL recommended program, Bolting Integrity Program, and the External Surfaces Monitoring Program for periodic visual inspections of the components.

The staff determined that the External Surfaces Monitoring Program, which includes periodic visual inspections of external surfaces performed during system walkdowns, is adequate to manage loss of material due to general, pitting and crevice corrosion for steel components exposed to outdoor air (external) addressed by this AMR. On the basis of periodic visual inspections being performed during system walkdowns of these components, the staff finds the applicant's use of the External Surfaces Monitoring program acceptable.

LRA Table 3.2.1, Item 3.2.1-23, and LRA Table 3.3.1, Item 3.3.1-43 address loss of material due to general, pitting and crevice corrosion for steel components with their external surfaces exposed to outdoor air or uncontrolled indoor air in the auxiliary and fuel handling building ventilation system, the auxiliary steam system, closed cycle cooling water system, containment isolation system, instrument and control air system, miscellaneous floor and equipment drains system and the radwaste system. The staff noted that for those AMR line items in LRA Section 3.3, in which the applicant references Item 3.2.1-23 and Item 3.3.1-43, the applicant listed the environment as air with borated water leakage, which is a more aggressive environment, compared to outdoor air or uncontrolled indoor air. The staff confirmed in LRA Section 3.3, that for the same system, component, material and environment combination, the applicant manages loss of material due to boric acid corrosion with the Boric Acid Corrosion Program, as recommended by the GALL Report.

The LRA credits the External Surfaces Monitoring Program to manage this aging effect for steel bolting, damper housing, ducting, filter housing, flow device, heat exchanger components, piping, fittings, pump casings, regulator, sight glass, spectacle blind, steam trap, strainer body and tank components in an air with borated water leakage environment only. The GALL Report recommends GALL AMP XI.M18, “Bolting Integrity,” to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with GALL Report material, environment, and aging effect, but a different aging management program is credited.

The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Sections 3.0.3.2.16. The staff noted from its review that all but one AMR line item that the applicant referenced Item 3.2.1-23 and Item 3.3.1-43 and credited the External Surfaces Monitoring Program are not bolting components with an intended function for mechanical closure. The staff further noted that the applicant referenced Item 3.2.1-23 of LRA Table 3.2.1 and Item 3.3.1-43 of LRA Table 3.3.1 because there was not another applicable Table 1 line item in LRA Table 3.2.1 and LRA Table 3.3.1 that corresponded to the same material, environment and aging effect combination. The staff confirmed that for the one AMR line item in this review that a bolting component with an intended function for mechanical closure was listed, the applicant also credited the Bolting Integrity Program, which is recommended by the GALL Report. The staff noted that the applicant was taken a conservative approach by crediting the GALL recommended program, Bolting Integrity Program, and the External Surfaces Monitoring Program for periodic visual inspections of the components for this aging effect.

The staff determined that the External Surfaces Monitoring program, which includes periodic visual inspections of external surfaces performed during system walkdowns, is adequate to manage loss of material due to general, pitting and crevice corrosion for steel components exposed to air with borated water leakage environment addressed by this AMR. On the basis of periodic visual inspections being performed during system walkdowns of these components by the External Surfaces Monitoring Program, and the applicant monitoring these components with the Boric Acid Corrosion Program, for loss of material due to boric acid corrosion, the staff finds the applicant's use of the External Surfaces Monitoring program acceptable.

Based on a review of the programs identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.3 Loss Of Material Due To Pitting And Crevice Corrosion

LRA Table 3.3.1, Item 3.3.1-54 addresses loss of material due to pitting and crevice corrosion for stainless steel components with its internal surfaces exposed to wetted air/gas in the emergency diesel generators and auxiliary systems, miscellaneous floor and equipment drains system and the radwaste system.

The LRA credits the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, to manage this aging effect for stainless steel piping, fittings, pump casings, tanks and valve body components in a wetted air/gas environment only. The GALL Report recommends GALL AMP XI.M24, "Compressed Air Monitoring," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with GALL Report material, environment, and aging effect, but a different aging management program is credited.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff noted that the wetted air/gas environment is not the same as a compressed air environment for which GALL AMP XI.M24 is intended to manage, and thus cannot be used for aging management. The staff determined that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, which include periodic visual inspections and volumetric testing, when appropriate, during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections, is adequate to manage loss of material due to pitting and crevice corrosion for stainless steel components exposed to wetted air/gas (internal) addressed by this AMR. On the basis of periodic visual inspections, the staff finds the applicant's use of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program acceptable.

In LRA Table 3.3.2-10, the applicant stated that loss of material due to pitting and crevice corrosion of stainless steel sprinkler heads exposed to wetted air in the fire protection system is managed by the Fire Water System Program.

The staff noted that the applicant applied note E to this item. The applicant referenced LRA Table 3.3-1, item 3.3.1-54 and GALL Report Volume 2, item VII.D-4. The staff reviewed the AMR results lines that reference Generic Note E and finds that the component type, material, environment, and aging effect are consistent with the GALL Report. However, the staff noted that where the GALL Report recommends AMP XI.M24, "Compressed Air Monitoring," the applicant proposed using the Fire Water System Program. The staff noted that these components are in the fire protection system and therefore, will not be in the scope of the Compressed Air Monitoring Program.

The staff reviewed the Fire Water System program, which manages aging effect of loss of material for the water-based fire protection system and associated components, through the use of periodic inspections, monitoring, and performance testing, and is consistent with the GALL AMP XI.M27, Fire Water System. As recommended by the GALL AMP XI.M27, the applicant has committed to testing or replacement of sprinkler heads in service for 50 years. The staff's review of the Fire Water System program and its evaluation is documented in SER Section 3.0.3.2.10. On the basis that periodic inspections, monitoring and performance testing will be performed, the staff finds that the Fire Water System program will adequately manage loss of material due to pitting and crevice corrosion of stainless steel sprinkler heads exposed to wetted air in the fire protection system through the period of extended operation.

In LRA Table 3.3.2-10, the applicant stated that loss of material due to pitting and crevice corrosion of stainless steel spray nozzles exposed to wetted air in the fire protection system is managed by the Fire Protection Program. The staff noted that the applicant applied note E to this item. The applicant referenced LRA Table 3.3-1, item 3.3.1-54 and GALL Report Volume 2, item VII.D-4. The staff reviewed the AMR results lines that reference note E and determines that the component type, material, environment, and aging effect are consistent with the GALL Report. However, the staff noted that where the GALL Report recommends AMP XI.M24, "Compressed Air Monitoring," the applicant proposed using the Fire Protection program. The staff noted that these components are in the fire protection system and therefore, will not be in the scope of the Compressed Air Monitoring Program.

The staff reviewed the Fire Protection program, which includes monitoring, testing, and inspection activities including low-pressure carbon dioxide fire suppression system flow testing to verify flow from each nozzle. The staff also noted that that any adverse conditions such as excessive dirt or debris, or other degrading condition are required to be reported for corrective action evaluation. The staff's review of the Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.9. On the basis that monitoring and testing on a periodic interval will be performed, the staff finds that the Fire Protection Program will adequately manage loss of material due to pitting and crevice corrosion of stainless steel spray nozzles exposed to wetted air in the fire protection system through the period of extended operation.

LRA Table 3.3.1, line item 3.3.1-54 addresses loss of material due to pitting and crevice corrosion for stainless steel components with their internal surfaces exposed to wetted air/gas in the condensers & air removal system. The staff noted that the applicant referenced line item 3.3.1-54 of LRA Table 3.3.1 because there was not an applicable Table 1 line item in LRA Table 3.4.1 that corresponded to the same material, environment and aging effect combination.

The LRA credits the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, to manage this aging effect for stainless steel thermowells and valve body components in a wetted air/gas environment only. The GALL Report recommends GALL AMP XI.M24, "Compressed Air Monitoring," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with the GALL Report material, environment, and aging effect, but a different aging management program is credited.

The staff reviewed the applicant's Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff noted that the wetted air/gas environment is not the same as a compressed air environment for which GALL AMP XI.M24 is intended to manage, and thus GALL AMP XI.M24 cannot be used for aging management. The staff determined that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, which includes periodic visual inspections and volumetric testing, when appropriate, during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections, is adequate to manage loss of material due to pitting and crevice corrosion for stainless steel components exposed to wetted air/gas (internal) addressed by this AMR. On the basis of periodic visual inspections, the staff finds the applicant's use of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program acceptable.

LRA Table 3.5.1, Items 3.5.1-47 and 3.5.1-50, address loss of material due to pitting and crevice corrosion for copper alloys (with 15% zinc or more and with less than 15% zinc) and stainless steel components, respectively, with their external surfaces exposed to outdoor air in the fire protection system and the auxiliary and fuel handling building ventilation system. The staff noted that the applicant referenced Item 3.5.1-47 and Item 3.5.1-50 of LRA Table 3.5.1 because there was not an applicable Table 1 line item in LRA Table 3.3.1 that corresponded to the same material, environment and aging effect combination.

The LRA credits the External Surfaces Monitoring Program to manage this aging effect for coppery alloys (with 15% zinc or more and with less than 15% zinc) sprinkler and valve body components and stainless piping, fittings, valve body, sprinkler and spray nozzle components in an outdoor air (external) environment only. The GALL Report recommends GALL AMP XI.S6, "Structures Monitoring Program," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with GALL Report material, environment, and aging effect, but a different aging management program is credited.

The staff reviewed the External Surfaces Monitoring Program and its evaluation is documented in SER Sections 3.0.3.2.16. The staff determined that the External Surfaces Monitoring Program, which includes periodic visual inspections of external surfaces performed during system walkdowns, is adequate to manage loss of material due to pitting and crevice corrosion for copper alloys (with 15% zinc or more and with less than 15% zinc) and stainless steel components exposed to outdoor air (external) addressed by this AMR. On the basis of periodic visual inspections being performed during system walkdowns of these components, the staff finds the applicant's use of the External Surfaces Monitoring Program acceptable.

Based on a review of the programs identified, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.4 Loss Of Material Due To General Corrosion

In LRA Table 3.3.2-10, the applicant stated that loss of material due to general corrosion of fire protection system steel fire barrier doors and penetration seals in an external environment of air-indoor is managed by the Fire Protection Program.

The staff noted that the applicant applied note E to this item. The applicant referenced LRA Table 3.3-1, item 3.3.1-58 and GALL Report Volume 2, item VII.I-8. The staff reviewed the AMR results lines that reference Generic Note E and determines that the component type, material, environment, and aging effect are consistent with the GALL Report. However, the staff noted that where the GALL Report recommends AMP XI.M36, "External Surface Monitoring," the applicant proposed using the Fire Protection Program.

GALL AMP XI.M36 recommends periodic visual inspection of the external surface of components. The staff reviewed the Fire Protection Program, which provides for periodic visual inspection of fire barrier penetration seals; fire barrier walls, ceilings and floors; and fire doors for managing loss of material due to corrosion and finds that it is consistent with GALL AMP XI.M26, "Fire Protection." The staff's review of the Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.9. On the basis that periodic visual inspection is performed, the staff finds that the Fire Protection Program will adequately manage loss of material due to general corrosion of fire protection system steel fire barrier doors and penetration seals in an external environment of air-indoor.

Based on a review of the program identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.5 Loss Of Material Due To General, Pitting, And Crevice Corrosion

In LRA Table 3.3.2-10, the applicant stated that loss of material due to general, pitting and crevice corrosion of fire protection system steel fire barrier doors exposed to outdoor air environment is managed by the Fire Protection Program.

The staff noted that the applicant applied Generic Note E to this item. The applicant referenced LRA Table 3.3-1, item 3.3.1-60 and GALL Report Volume 2, item VII.H1-8. The staff reviewed the AMR results lines that reference note E and finds that the component type, material, environment, and aging effect are consistent with the GALL Report. However, the staff noted that where the GALL Report recommends AMP XI.M36, "External Surface Monitoring," the applicant proposed using the Fire Protection Program.

GALL AMP XI.M36 recommends periodic visual inspection of the external surface of components. The staff reviewed the Fire Protection Program, which provides for periodic visual inspection of fire barrier penetration seals; fire barrier walls, ceilings and floors; and fire doors for managing loss of material due to corrosion and finds that it is consistent with GALL AMP XI.M26, "Fire Protection." The staff's review of the Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.9. On the basis that periodic visual inspection is performed, the staff finds that the Fire protection Program will adequately manage loss of material due to general, pitting and crevice corrosion of fire protection system steel fire barrier doors in an outdoor air environment during the period of extended operation.

Based on a review of the program identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.6 Loss Of Material Due To Pitting And Crevice Corrosion

In LRA Table 3.3.2-10, the applicant stated that loss of material due to pitting and crevice corrosion of aluminum piping components exposed to raw water in the fire protection system is managed by the Fire Water System Program.

The staff noted that the applicant applied Generic Note E to this item. The applicant referenced LRA Table 3.3-1, item 3.3.1-62 and GALL Report Volume 2, item VII.G-8. The staff reviewed the AMR results lines that reference Generic Note E and finds that the component type, material, environment, and aging effect are consistent with the GALL Report. However, the staff noted that where the GALL Report recommends AMP XI.M26, "Fire Protection," the applicant proposed using the Fire Water System Program. The staff noted that these components are in water-based fire protection system and therefore are not in the scope of the Fire Protection Program.

The staff reviewed the Fire Water System Program, which manages identified aging effects for the water-based fire protection system and associated components, through the use of periodic inspections, monitoring, and performance testing, and finds that it is consistent with the GALL AMP XI.M27, "Fire Water System." The staff's review of the Fire Water System Program and its evaluation is documented in SER Section 3.0.3.2.10. On the basis that periodic inspections, monitoring and performance testing will be performed, the staff finds that the Fire Water System Program will adequately manage loss of material due to pitting and crevice corrosion of aluminum piping components exposed to raw water in the fire protection system through the period of extended operation.

Based on a review of the program identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.7 Loss Of Material Due To General, Pitting, Crevice, And Microbiologically-influenced Corrosion, And Fouling

LRA Table 3.3.1, Item 3.3.1-68 addresses loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling for steel components with its external and internal surfaces exposed to raw water in the Miscellaneous Floor and Equipment Drains System and the Closed Cycle Cooling Water System.

The LRA credits the AMP B.2.1.22, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," to manage this aging effect for steel flow devices, heat exchanger components, pump casings, spectacle blinds, strainer body, piping, fittings, tanks and valve body components in a raw water (internal) environment only. The LRA credits the AMP B.2.1.21 "External Surfaces Monitoring" to manage this aging effect for steel pump casings components in a raw water (external) environment only. The GALL Report recommends GALL AMP XI.M27, "Fire Water System," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with the GALL Report material, environment, and aging effect, but a different aging management program is credited. The staff confirmed that only piping, piping components and piping elements align to GALL Item VII.G-24 and are fabricated from steel materials that are applicable to TMI.

The staff reviewed the applicant's Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program and External Surfaces Monitoring program and its evaluations are documented in SER Sections 3.0.3.2.16 and 3.0.3.2.17, respectively. The staff noted that the program that is recommended by the GALL Report was meant to specifically address this aging effect for Fire Protection Systems that are tested in accordance with NFPA codes and standards. However, the staff further noted that the applicant referenced Item 3.3.1-68 of LRA Table 3.3.1 because there was not another applicable Table 1 line item in LRA Table 3.3.1 that corresponded to the same material, environment and aging effect combination. The systems in which the applicant's AMR Line items that are discussed in this section are not Fire Protection Systems; they are the Miscellaneous Floor and Equipment Drains System and the Closed Cycle Cooling Water System.

The staff determined that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program, which includes periodic visual inspections and volumetric testing, when appropriate, during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections, is adequate to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling for steel components exposed to raw water (internal) addressed by this AMR. The staff determined that the External Surfaces Monitoring program, which includes periodic visual inspections of external surfaces performed during system walkdowns, is adequate to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling for steel components exposed to raw water (internal) addressed by this AMR.

On the basis of periodic visual inspections and volumetric testing, when appropriate, the staff finds the applicant's use of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program acceptable. On the basis of periodic visual inspections, the staff finds the applicant's use of the External Surfaces Monitoring program acceptable.

Based on a review of the programs identified, the staff determines that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.8 Loss Of Material Due To General, Pitting, And Crevice Corrosion

In LRA Table 3.3.2-10, the applicant stated that loss of material due to general, pitting and crevice corrosion of fire protection system steel spray nozzles exposed to air-gas wetted internal environment is managed by the Fire Protection Program.

The staff noted that the applicant applied Generic Note E to this item. The applicant referenced LRA Table 3.3-1, item 3.3.1-71 and GALL Report Volume 2, item VII.G-23. The staff reviewed the AMR results lines that reference Generic Note E and determines that the component type, material, environment, and aging effect are consistent with the GALL Report. However, the staff noted that where the GALL Report recommends AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," the applicant proposed using the Fire Protection Program.

GALL AMP XI.M38 recommends periodic visual inspection of the internal surface of components when accessible during performance of maintenance or surveillance activities. The staff noted that these spray nozzles are in the halon and carbon dioxide fire protection system. The staff reviewed the Fire Protection Program, which provides for periodic visual inspection and performance testing of halon and carbon dioxide system components, including spray nozzles, which are open to atmosphere, for managing loss of material due to corrosion and finds that it is consistent with GALL AMP XI.M26, "Fire Protection." The staff's review of the Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.9. On the basis that periodic visual inspection is performed, the staff finds that the Fire protection Program will adequately manage loss of material due to general, pitting and crevice corrosion of fire protection system steel spray nozzles exposed to air-gas wetted internal environment during the period of extended operation.

In LRA Table 3.3.2-14, the applicant stated that loss of material due to general, pitting and crevice corrosion of instrument and control air system steel piping and fittings, heat exchanger components, filter housing, pump casing, tanks and valve bodies exposed to air/gas wetted internal environment is managed by the Compressed Air Monitoring Program.

The staff noted that the applicant applied Generic Note E to this item. The applicant referenced LRA Table 3.3-1, item 3.3.1-71 and GALL Report Volume 2, item VII.G-23. The staff reviewed the AMR results lines that reference Generic Note E and finds that the component type, material, environment, and aging effect are consistent with the GALL Report. However, the staff noted that where the GALL Report recommends AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," the applicant proposed using the Compressed Air Monitoring Program.

GALL AMP XI.M38 recommends periodic visual inspection of the internal surface of components when accessible during performance of maintenance or surveillance activities. Since these components are in the instrument and control air system, the applicant has proposed the Compressed Air Monitoring Program. The staff reviewed the Compressed Air Monitoring Program, which includes periodic visual inspection of internal surfaces of piping and heat exchanger components for loss of material and fouling, monitoring of system air quality in accordance with industry standards and guidelines, and finds that it is consistent with the GALL AMP XI.M24, "Compressed Air Monitoring." The staff's review of the Compressed Air Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.8. On the basis that periodic visual inspection of internal surfaces of piping and heat exchanger components is performed, the staff finds that the Compressed Air Monitoring program will adequately manage loss of material due to general, pitting and crevice corrosion of instrument and control air system steel piping and fittings, heat exchanger components, filter housing, pump casing, tanks and valve bodies exposed to air/gas wetted internal environment through the period of extended operation.

Based on a review of the programs identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.9 Loss Of Material Due To General, Pitting, Crevice, And (For Drip Pans And Drain Lines) Microbiologically-influenced Corrosion

In LRA Table 3.3.2-14, the applicant stated that loss of material due to general, pitting, crevice and microbiologically-influenced corrosion of control building ventilation system steel air dryer exposed to air/gas wetted internal environment is managed by the Compressed Air Monitoring Program.

The staff noted that the applicant applied Generic Note E to this item. The applicant referenced LRA Table 3.3-1, item 3.3.1-72 and GALL Report Volume 2, item VII.F1-3. The staff reviewed the AMR results lines that reference Generic Note E and finds that the component type, material, environment, and aging effect are consistent with the GALL Report. However, the staff noted that where the GALL Report recommends AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," the applicant proposed using the Compressed Air Monitoring Program.

GALL AMP XI.M39 recommends periodic visual inspection of the internal surface of components when accessible during performance of maintenance or surveillance activities. Since the component is an air dryer, the applicant has proposed using the Compressed Air Monitoring Program. The staff reviewed the Compressed Air Monitoring Program, which includes periodic visual inspections of internal surfaces of piping and heat exchanger components for loss of material and fouling and monitoring of system air quality in accordance with industry standards and guidelines, and finds that it is consistent with the GALL AMP XI.M24, "Compressed Air Monitoring." The staff's review of the Compressed Air Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.8. On the basis that periodic visual inspection of internal surfaces of piping and heat exchanger components is performed, the staff finds that the Compressed Air Monitoring Program will adequately manage loss of material due to general, pitting, crevice and microbiologically-influenced corrosion of control building ventilation system steel air dryer exposed to air/gas wetted internal environment through the period of extended operation.

Based on a review of the program identified above, the staff determines that the applicant's proposed program is acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.10 Loss Of Material Due To General, Pitting, Crevice, And Microbiologically-influenced Corrosion, Fouling, And Lining/Coating Degradation

LRA Table 3.3.1, Item 3.3.1-76 addresses loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling for steel components with their internal surfaces exposed to raw water in the water treatment and distribution system.

The LRA credits the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, to manage this aging effect for steel piping, piping and flow components, pump casings, tanks and valve body components in a raw water (internal) environment only. The GALL Report recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with the GALL Report material, environment, and aging effect, but a different aging management program is credited. The staff confirmed that only piping, piping components and piping elements align to GALL Item VII.C1-19 and are fabricated from steel materials that are applicable to TMI.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff determined that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, which includes periodic visual inspections and volumetric testing, when appropriate, during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections, is adequate to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling for steel components exposed to raw water (internal) addressed by this AMR. On the basis of periodic visual inspections, the staff finds the applicant's use of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program acceptable.

Based on a review of the programs identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.11 Loss Of Material Due To Pitting And Crevice Corrosion

LRA Table 3.3.1, Item 3.3.1-78 addresses loss of material due to pitting and crevice corrosion for stainless steel and nickel alloy components with internal surfaces exposed to raw water in the miscellaneous floor and equipment drains system and radwaste system.

The LRA credits the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, to manage this aging effect for nickel alloy and stainless steel piping, fittings and various floor sump tank components in an internal raw water environment only. The GALL Report recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with GALL Report material, environment, and aging effect, but a different aging management program is credited. The staff noted that these AMR Line items in the reactor building sump and drain system are not in the scope of an open-cycle cooling water system as described in GL 89-13, and therefore is not within the scope of GALL AMP XI.M20, "Open-Cycle Cooling Water System."

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff determined that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, which includes periodic visual inspections and volumetric testing, when appropriate, during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections, is adequate to manage loss of material due to pitting and crevice corrosion for stainless steel and nickel alloy components exposed to raw water environment (internal) addressed by this AMR. On the basis of periodic visual inspections, the staff finds the applicant's use of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program acceptable.

Based on a review of the programs identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.12 Loss Of Material Due To Pitting, Crevice, And Microbiologically-influenced Corrosion

In LRA Table 3.3.2-10, the applicant stated that loss of material due to pitting, crevice, and microbiologically-influenced corrosion of fire protection system stainless steel piping, flow elements, restricting orifices, sprinkler heads, strainer element and valve body in an internal environment of raw water is managed by the Fire Water System Program.

The staff noted that the applicant applied Generic Note E to this item. The applicant referenced LRA Table 3.3-1, item 3.3.1-80 and GALL Report Volume 2, item VII.H2-18. The staff reviewed the AMR results lines that reference Generic Note E and finds that the component type, material, environment, and aging effect are consistent with the GALL Report. However, the staff noted that where the GALL Report recommends AMP XI.M20, "Open-Cycle Cooling Water System," the applicant proposed using the Fire Water System program. The staff noted that these components are in the fire protection system and will not be in the scope of the GL 89-13 program as dictated by the Open-Cycle Cooling Water Program.

GALL AMP XI.M20, "Open-Cycle Cooling Water System" recommends performance testing and inspection to manage the effects of loss of material. The staff reviewed the Fire Water System Program, which manages identified aging effects for the water-based fire protection system and associated components, through the use of periodic inspections, monitoring, and performance testing and provides for preventive measures and inspection activities to detect aging effects prior to loss of intended functions, and finds that it is consistent with the GALL AMP XI.M27, "Fire Water System." The staff's review of the Fire Water System Program and its evaluation is documented in SER Section 3.0.3.2.10. On the basis that periodic inspection, monitoring and performance testing will be performed, the staff finds that the Fire Water System Program will adequately manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion of stainless steel piping, flow elements, restricting orifices, sprinkler heads, strainer element and valve body in an internal environment of raw water in the fire protection system through the period of extended operation.

Based on a review of the programs identified, the staff determines that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.13 Loss Of Material Due To Pitting, Crevice, And Microbiologically-influenced Corrosion, And Fouling

LRA Table 3.3.1, Item 3.3.1-81 addresses loss of material due to pitting, crevice, and microbiologically-influenced corrosion, and fouling for copper alloy (with 15% zinc or more and with less than 15% zinc) components with its internal surfaces exposed to raw water in the miscellaneous floor and equipment drains system and the water treatment and distribution system.

The LRA credits the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, to manage this aging effect for copper alloy (with 15% zinc or more and with less than 15% zinc) piping, fittings, tanks and valve body components in a raw water (internal) environment only. The GALL Report recommends GALL AMP XI.M20, "Open-Cycle Cooling Water System," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with the GALL Report material, environment, and aging effect, but a different aging management program is credited. The staff confirmed that only piping, piping components and piping elements align to GALL Item VII.C1-9 and are fabricated from copper alloy materials that are applicable to TMI.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff determined that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, which includes periodic visual inspections and volumetric testing, when appropriate, during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections, is adequate to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion, and fouling for copper alloy (with 15% zinc or more and with less than 15% zinc) components exposed to raw water (internal) addressed by this AMR. On the basis of periodic visual inspections and volumetric testing, when appropriate, the staff finds the applicant's use of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program acceptable.

Based on a review of the programs identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.14 Loss Of Material Due To General, Pitting, And Crevice Corrosion

In LRA Table 3.3.2-10, the applicant stated that loss of material due to general, pitting and crevice corrosion of fire protection system steel fire barrier doors and penetration seals exposed to air with borated water leakage external environment are managed by the Fire Protection Program.

The staff noted that the applicant applied Generic Note E to this item. The applicant referenced LRA Table 3.3-1, item 3.3.1-86 and GALL Report Volume 2, item VII.A1-1. The staff reviewed the AMR results lines that reference Generic Note E and determines that the component type, material, environment, and aging effect are consistent with the GALL Report. However, the staff noted that where the GALL Report recommends AMP XI.S6, "Structures Monitoring Program," the applicant proposed using the Fire Protection Program.

In RAI 3.3.2-10-1, dated October 16, 2008, the staff requested that the applicant provide additional information to explain why GALL Report item VII.A1-1 was used, since this item is for steel components in an air-indoor environment, and not an air with borated water leakage environment. The staff noted that the applicant referenced GALL Report item III.B5-8 for fire doors in LRA Tables 3.5.2-2 and 3.5.2-7. The staff also asked the applicant to justify why it used the Fire Protection Program and not the Boric Acid Corrosion Program, and which program will be used to evaluate and control boric acid leakage.

In its response to the RAI dated November 12, 2008, the applicant stated that in its aging management review process, for steel components in air with borated water leakage environment, it considered loss of material due to boric acid leakage, and due to general, pitting and crevice corrosion. The applicant also mentioned that GALL Report item VII.A1-1 was referenced for loss of material due to general, pitting and crevice corrosion, and item VII.I-10 was referenced for loss of material due to boric acid leakage because the fire protection system is included in GALL Report Chapter VII, Auxiliary Systems and not in Chapter III, which is for structures.

The applicant further stated that both the Fire Protection Program and the Boric Acid Corrosion Program are credited in the LRA. The Fire Protection Program is credited for managing loss of material due to general, pitting and crevice corrosion, whereas the Boric Acid Corrosion Program is credited for managing loss of material due to boric acid leakage. In all cases, the applicant stated, the Boric Acid Corrosion Program is used to evaluate and control boric acid leakage.

Based on its review, the staff finds the applicant's response to the RAI acceptable because the applicant has credited the Boric Acid Corrosion Program to manage loss of material due to boric acid leakage and is using the Fire Protection Program to manage loss of material due to general, pitting and crevice corrosion. Furthermore, the staff finds the use of GALL Report item VII.A1-1 to be acceptable since the fire protection system is part of the GALL Report Chapter VII, Auxiliary Systems. The staff reviewed the Fire Protection Program, which provides for periodic visual inspection of fire barrier penetration seals; fire barrier walls, ceilings and floors; and fire doors for managing loss of material due to corrosion and is consistent with GALL AMP XI.M26, "Fire Protection." The staff's review of the Fire Protection program and its evaluation is documented in SER Section 3.0.3.2.9. On the basis that periodic visual inspection is performed, the staff finds that the Fire Protection Program will adequately manage loss of material due to general, pitting and crevice corrosion of fire protection system steel fire barrier doors and penetration seals exposed to air with borated water leakage external environment during the period of extended operation.

Based on a review of the programs identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.15 Loss of Material due to General, Pitting, Crevice, and Galvanic Corrosion

In LRA Table 3.3.1, item 3.3.1-48, the applicant stated that the AMR result is not consistent with the GALL Report. LRA Tables 3.3.2-9 and 3.3.2-22 include AMR result lines referencing item 3.3.1-48 where carbon steel components in a closed-cycle cooling water environment have an aging effect of loss of material due to general, pitting and crevice corrosion and the recommended AMP is the Closed-Cycle Cooling Water System program. For these AMR result lines the applicant cited generic note I, indicating that the aging effect in the GALL Report for the component, material and environment combination is not applicable. The applicant also included a plant-specific note stating that loss of material due to galvanic corrosion is not predicted because materials that cause galvanic corrosion are not in contact with the component.

The staff noted that the applicant appeared to be citing Generic Note I to indicate that the aging effect due to one mechanism, galvanic corrosion, is not present, rather than to indicate that the aging effect is not present at all. In RAI 3.3.2-48-1, dated October 16, 2008, the staff requested that the applicant provide additional information to clarify the meaning of Generic Note I, as used for these AMR result lines.

In its response to the RAI dated November 12, 2008, the applicant stated that Generic Note I in the LRA 3.x.2 AMR tables is applied when the component, material and environment combination exists but *the aging effect, or any of the identified aging mechanisms associated with the aging* effect, in the GALL Report is not predicted. The applicant stated that in these cases, the GALL Report Table 1 item number is identified in the LRA 3.x.1 aging management summary tables as being applicable and the specific aging effect/mechanism that is not predicted is identified in the item discussion column or in the evaluation paragraph where the GALL Report specifies further evaluation. The applicant further stated that in accordance with EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guidelines and Mechanical Tools," Revision 4, galvanic corrosion is not predicted for component, material, and environment combinations when the material subject to AMR is not in contact with a material of different electrochemical potential, and that in these cases the Table 3.x.2 AMR line items are identified with generic note I.

Because the applicant cited Generic Note I for AMR results where one aging mechanism, rather than the aging effect due to all mechanisms, does not occur, the staff finds that the applicant's use of generic note I does not indicate an inconsistency with comparable AMR results in the GALL Report. Because the component, material, environment and aging effect combination (except for one aging mechanism) is consistent with the GALL Report and the AMP proposed by the applicant is the same as the AMP recommended in the GALL Report, the staff finds that the applicant's AMR results are consistent with the GALL Report and are acceptable.

Based on its review, the staff finds the applicant's response to RAI 3.3.2-48-1 acceptable because the applicant's use of Generic Note I does not indicate an inconsistency with comparable AMR results in the GALL Report. The staff also finds that because the component, material, environment and aging effect combination (except for one aging mechanism) is consistent with the GALL Report, and the AMP proposed by the applicant is the same as the AMP recommended in the GALL Report, the AMR results are consistent with the GALL Report. The staff's concern described in RAI 3.3.2-48-1 is resolved.

Based on the programs identified, the staff concludes that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

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

In LRA Table 3.3.1, item 3.3.1-51, the applicant stated that the AMR result is not consistent with the GALL Report. LRA Tables 3.3.2-4, 3.3.2-6, 3.3.1-9, 3.3.2-22 and 3.3.2-24 include AMR results referencing item 3.3.1-51 where copper alloy components in a closed-cycle cooling water environment have an aging effect of loss of material due to pitting and crevice corrosion and the recommended AMP is the Closed-Cycle Cooling Water System program. For these AMR results the applicant cited generic note I, indicating that the aging effect in the GALL Report for the component, material and environment combination is not applicable. The applicant also included a plant-specific note stating that loss of material due to galvanic corrosion is not predicted because materials that cause galvanic corrosion are not in contact with the component.

The staff noted that the applicant appeared to be citing note I to indicate that the aging effect due to one mechanism, galvanic corrosion, is not present, rather than to indicate that the aging effect is not present at all. In a letter dated October 16, 2008, the staff issued RAI 3.3.1-48-1 and requested that the applicant provide additional information to clarify the meaning of generic note I, as used for these AMR result lines.

In its response to the RAI dated November 12, 2008, the applicant stated that generic note I in the LRA 3.x.2 AMR tables is applied when the component, material and environment combination exists but the aging effect, or any of the identified aging mechanisms associated with the aging effect in the GALL Report is not predicted. The applicant stated that in these cases, the GALL Report Table 1 item number is identified in the LRA 3.x.1 aging management summary tables as being applicable and the specific aging effect/mechanism that is not predicted is identified in the item discussion column or in the evaluation paragraph where the GALL Report specifies further evaluation. The applicant further stated that in accordance with EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guidelines and Mechanical Tools," Revision 4, galvanic corrosion is not predicted for component, material, and environment combinations when the material subject to AMR is not in contact with a material of different electrochemical potential, and that in these cases the Table 3.x.2 AMR line items are identified with generic note I.

Based on its review, the staff finds the applicant's response to RAI 3.3.1-48-1 acceptable because the applicant cited generic note I for AMR results where one aging mechanism, rather than the aging effect due to all mechanisms, does not occur which does not indicate an inconsistency with comparable AMR results in the GALL Report. Because the component, material, environment and aging effect combination (except for one aging mechanism) is consistent with the GALL Report and the AMP proposed by the applicant is the same as the AMP recommended in the GALL Report, the staff finds that the applicant's AMR results are consistent with the GALL Report and are acceptable. The staff's concern in RAI 3.3.1-48-1 is resolved.

Based on the programs identified, the staff concludes that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.17 Loss of Material due to General, Pitting, Crevice, and Microbiologically-influenced Corrosion, Fouling, and Lining/Coat Degradation

LRA Table 3.3.2-25 includes AMR results for carbon steel, ductile cast iron and gray cast iron components in a raw water environment in the water treatment and distribution system where the aging effect of loss of material is managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components AMP. For these AMR results, the applicant referred to LRA Table 3.3.1, item 3.3.1-76, where the AMP recommended by the GALL Report is the Open-Cycle Cooling Water System program, and cited generic note E indicating that the result is consistent with the GALL Report for material, environment and aging effect, but a different aging management program is used.

In a letter dated October 16, 2008, the staff issued RAI 3.3.2-25-1 requesting that the applicant provide additional information to explain why an AMP different from the one recommended in the GALL Report is being used for these components.

In its response to the RAI dated November 12, 2008, the applicant stated that the raw water environment in the water treatment and distribution system includes domestic water, filtered water, and other non-demineralized water sources. The applicant stated that these environments are not considered raw cooling water and, as such, are not addressed by the activities of the Open-Cycle Cooling Water System AMP. The applicant further stated that these environments are not addressed by the activities of the Water Chemistry AMP.

The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components AMP includes internal inspections that are performed during periodic system and component inspections and during the performance of maintenance activities when the surfaces are made accessible for inspection. The applicant stated that the program includes visual inspections to assure that environmental conditions are not resulting in material degradation such as loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling and that material degradation identified during the inspections will be entered into the corrective action process for further evaluation.

The staff reviewed the applicant's RAI response and the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program. The staff's evaluation of this program, which is documented in SER Section 3.0.3.2.17, determined that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program, with an acceptable exception, is consistent with GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," and provides for visual inspections of internal surfaces of plant components to be performed during maintenance or surveillance activities, including visible evidence of corrosion to indicate possible loss of materials. The staff noted that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program includes evaluation of indications of corrosion or fouling to determine whether component intended function is affected and requires corrective actions in accordance with the site's corrective action program and quality assurance procedures. The staff's concern in RAI 3.3.2-25-1 is resolved.

Based on its review, the staff finds the applicant's response to RAI 3.3.2-25-1 acceptable because the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program includes detection of loss of material and requires appropriate corrective actions if loss of material affecting component intended function is found. The staff finds that the applicant's use of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program to manage loss of material in carbon steel, ductile cast iron and gray cast iron components in a raw water environment in the water treatment and distribution system to be acceptable. The staff's concern described in RAI 3.3.2-25-1 is resolved.

Based on the programs identified, the staff concludes that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.18 Loss of Material due to Pitting, Crevice, Galvanic and Microbiologically-influenced Corrosion and Fouling

In LRA Table 3.3.1, Item 3.3.1-82, the applicant stated that the AMR result is not consistent with the GALL Report. LRA Table 3.2.2-4 includes AMR result lines referring to Table 3.3.1, Item 3.3.1-82, where the copper alloy components in a raw water environment have an aging effect of loss of material due to pitting, crevice and microbiologically-influenced corrosion and fouling and the recommended AMP is the Open-Cycle Cooling Water System program. For these AMR result lines the applicant cited generic Note I, indicating that the aging effect in the GALL Report for the component, material and environment combination is not applicable. The applicant also included a plant-specific note stating that the aging mechanism of galvanic corrosion does not apply since the material is not in contact with material higher in galvanic series.

The staff noted that the applicant appeared to be citing note I to indicate that the aging effect due to one mechanism, galvanic corrosion, is not present, rather than to indicate that the aging effect is not present at all. In a letter dated October 16, 2008, the staff issued RAI 3.3.1-48-1 requesting that the applicant provide additional information to clarify the meaning of generic note I, as used for these AMR result lines.

In its response to the RAI dated November 12, 2008 the applicant stated that generic note I in the LRA 3.x.2 AMR tables is applied when the component, material and environment combination exists but the aging effect, or any of the identified aging mechanisms associated with the aging effect, in the GALL Report is not predicted. The applicant stated that in these cases, the GALL Report Table 1 item number is identified in the LRA 3.x.1 aging management summary tables as being applicable and the specific aging effect/mechanism that is not predicted is identified in the item discussion column or in the evaluation paragraph where the GALL Report specifies further evaluation. The applicant further stated that in accordance with EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guidelines and Mechanical Tools," Revision 4, galvanic corrosion is not predicted for component, material, and environment combinations when the material subject to AMR is not in contact with a material of different electrochemical potential, and that in these cases the Table 3.x.2 AMR line items are identified with generic note I.

Based on its review, the staff finds the applicant's response to the RAI acceptable because the applicant cited generic note I for AMR results where one aging mechanism, rather than the aging effect due to all mechanisms, does not occur, which does not indicate an inconsistency with comparable AMR results in the GALL Report. Because the component, material, environment and aging effect combination (except for one aging mechanism) is consistent with the GALL Report and the AMP proposed by the applicant is the same as the AMP recommended in the GALL Report, the staff finds that the applicant's AMR results are consistent with the GALL Report and are acceptable. The staff's concern described in RAI 3.3.1-48-1 is resolved.

Based on the programs identified, the staff concludes that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.19 Cracking due to Stress Corrosion Cracking, or Loss of Material due to Pitting and Crevice Corrosion

LRA Table 3.2.2-21 includes AMR result lines referring to Table 3.3.1, Items 3.3.1-90 or 3.3.1-91, for stainless steel components in a treated borated water environment in the radwaste system having aging effects of cracking due to stress corrosion cracking or loss of material due to pitting and crevice corrosion. For these components the applicant credited the One-Time Inspection program in addition to the Water Chemistry program for managing the aging effects in the components. For the AMR result lines using the One-Time Inspection Program, the applicant cited generic note E, indicating that the result line is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The applicant also cited a plant-specific note stating that for portions of the radwaste system which receive drainage of reactor and spent fuel pool grade borated treated water, plant operating experience is that aging effects progress very slowly but local environments may be more adverse than the general environment; the applicant states that the One-Time Inspection program will augment the Water Chemistry program by verifying the absence of aging effects.

The staff reviewed the applicant's One-Time Inspection program. The staff's evaluation of this program, which is documented in SER Section 3.0.3.2.14, determined that the One-Time Inspection program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence or note the absence of cracking due to SCC or of loss of material due to pitting and crevice corrosion. Because the One-Time Inspection program is used as an augmentation of the AMP recommended in the GALL report and provides added assurance that the aging effects are not present or are progressing slowly, the staff finds the AMPs specified by the applicant for these AMR result lines to be acceptable.

Based on a review of the programs identified above, the staff concludes that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation is Recommended

LRA Section 3.3.2.2 provides further evaluation of aging management, as recommended by the GALL Report, for the auxiliary systems components. The applicant provided information concerning how it will manage the following aging effects:

- Cumulative Fatigue Damage
- Reduction of Heat Transfer Due to Fouling
- Cracking due to SCC
- Cracking due to SCC and Cyclic Loading
- Hardening and Loss of Strength due to Elastomer Degradation
- Reduction of Neutron-Absorbing Capacity and loss of material due to General Corrosion
- Loss of Material due to General, Pitting, and Crevice Corrosion
- Loss of Material due to General, Pitting, Crevice, and MIC
- Loss of Material due to general, Pitting, Crevice, MIC and Fouling
- Loss of Material due to Pitting and Crevice Corrosion
- Loss of Material due to Pitting, Crevice, and Galvanic Corrosion
- Loss of Material due to Pitting, Crevice, and MIC
- Loss of Material due to Wear
- Loss of Material due to Cladding Breach

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report and for which the GALL Report recommends further evaluation, the staff audited and reviewed the applicant's evaluations to determine whether they adequately address those issues. In addition, the staff reviewed the applicant's further evaluations against the criteria in SRP-LR Section 3.3.2.2. The staff's review of the applicant's further evaluation follows.

3.3.2.2.1 Cumulative Fatigue Damage

Fatigue is an age-related degradation mechanism caused by cyclic stressing of a component by either mechanical or thermal stresses. SRP-LR Section 3.3.2.2.1 states that fatigue is a TLAA as defined in 10 CFR 54.3 and that TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). This TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis" or Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses" of the SRP-LR.

LRA Section 3.3.2.2.1 states that TLAAs are evaluated in accordance with 10 CFR 54.21(c) and that the evaluations of this TLAA are addressed in Sections 4.3 and 4.6. This is consistent with SRP-LR Section 3.3.2.2.1 and is, therefore, acceptable.

3.3.2.2.2 Reduction of Heat Transfer due to Fouling

The staff reviewed LRA Section 3.3.2.2.2 against the criteria in SRP-LR Section 3.3.2.2.2.

LRA Section 3.3.2.2.2 states that TMI-1 will implement a One-Time Inspection Program, to verify the effectiveness of the Water Chemistry Program, to manage the reduction of heat transfer due to fouling in stainless steel heat exchanger components exposed to treated water in the closed cycle cooling water system.

The staff reviewed LRA Section 3.3.2.2.2 against the criteria in SRP-LR Section 3.3.2.2.2, which states that reduction of heat transfer due to fouling could occur for stainless steel heat exchanger tubes exposed to treated water. The existing program relies on control of water chemistry to manage reduction of heat transfer due to fouling. However, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that reduction of heat transfer due to fouling is not occurring. A one-time inspection is an acceptable method to ensure that reduction of heat transfer is not occurring and that the component's intended function will be maintained during the period of extended operation.

SRP-LR Section 3.3.2.2.2 invokes AMR Item 3 in Table 3 of the GALL Report, Volume 1, and AMR Item VII.A4-4 in the GALL Report, Volume 2, as applicable to stainless steel heat exchanger tubes that are exposed to treated water.

The applicant stated that the Water Chemistry Program is consistent with EPRI 1002884, Pressurized Water Reactor Primary Chemistry Guidelines, Revision 5 and Plant Technical Specification limits for fluorides, chlorides, and dissolved oxygen and is consistent with GALL Report AMP XI.M2. The applicant also stated that the One-Time Inspection Program will be used to confirm the effectiveness of the Water Chemistry Program to manage the loss of material, cracking, and the reduction of heat transfer aging effects and is consistent with GALL Report AMP XI.M32. The staff's review of the Water Chemistry program and the One-Time Inspection program and its evaluation is documented in SER Sections 3.0.3.2.2 and 3.0.3.2.14 respectively.

On the basis that the Water Chemistry Program maintains water chemistry within acceptable limits, and the One-Time Inspection Program performs visual inspection to confirm the effectiveness of the Water Chemistry Program, the staff finds that the Water Chemistry Program and the One-Time Inspection Program will adequately manage reduction of heat transfer due to fouling for stainless steel heat exchanger tubes exposed to treated water through the period of extended operation.

Based on a review of the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.2 criteria. For those line items that apply to LRA Section 3.3.2.2.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.3 Cracking due to SCC

The staff reviewed LRA Section 3.3.2.2.3 against the criteria in SRP-LR Section 3.3.2.2.3.

(1) LRA Section 3.3.2.2.3 addresses cracking due to SCC, stating that this aging effect is not applicable to TMI-1, which is a PWR.

SRP-LR Section 3.3.2.2.3 states that cracking due to SCC could occur in the stainless steel piping, piping components, and piping elements of the BWR standby liquid control system that are exposed to sodium pentaborate solution greater than 60 °C (140 °F).

This line item is not applicable to TMI-1 because TMI-1 is a PWR. On this basis, the staff finds that the SRP-LR criteria do not apply to TMI-1.

(2) LRA Section 3.3.2.2.3.2 refers to LRA Table 3.3.1, line item 5, and addresses cracking due to stress corrosion cracking in stainless steel and stainless clad steel heat exchanger components exposed to treated water greater than 60 °C (greater than 140 °F). The applicant stated that the component, material, environment, and aging effect/mechanism does not apply to auxiliary systems.

The staff reviewed LRA Section 3.3.2.2.3.2 against the criteria in SRP-LR Section 3.3.2.2.3.2, which states that cracking due to SCC could occur in stainless steel and stainless clad steel heat exchanger components exposed to treated water greater than 60 °C (greater than 140 °F). The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed.

SRP-LR Section 3.3.2.2.3.2 invokes AMR Item 5 in Table 3 of the GALL Report, Volume 1, and AMR Items VII.E3-3 and VII.E3-19 in the GALL Report, Volume 2, as applicable to stainless steel and stainless clad steel heat exchanger components exposed to treated water greater than 60 °C (greater than 140 °F).

In the applicant's response to RAI-AMR-GENERIC-2, the applicant stated that line item 3.3.1-5 is not applicable because this component, material, environment, and aging effect/mechanism combination is addressed by item 3.4.1-14 from the steam and power conversion systems grouping and item 3.3.1-90. The applicant also stated that item 3.3.1-5 specifies a plant specific AMP which is satisfied by item 3.4.1-14, which specifies the Water Chemistry and One-Time Inspection AMPs. The applicant also stated that this combination is satisfied by item 3.3.1-90, which specifies the Water Chemistry AMP and that item 3.3.1-90 has been augmented in the aging management reviews to also include the One-Time Inspection AMP.

Based on its review of the LRA, the staff confirmed this component, material, environment, and aging effect/mechanism combination is addressed by item 3.4.1-14 from the steam and power conversion systems grouping and also addressed by item 3.3.1-90. The staff also confirmed that item 3.3.1-5 specifies a plant specific AMP which is satisfied by item 3.4.1-14, which specifies the Water Chemistry and One-Time Inspection AMPs and by item 3.3.1-90, which specifies the Water Chemistry AMP. The staff confirmed that item 3.3.1-90 has been augmented in the aging management reviews to also include the One-Time Inspection AMP. The staff finds the applicant's determination acceptable.

(3) LRA Section 3.3.2.2.3 addresses cracking due to stress corrosion cracking in stainless steel diesel engine exhaust piping, piping components and piping elements exposed to

diesel exhaust. The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will manage this aging effect in stainless steel internal surfaces exposed to diesel exhaust. The staff reviewed LRA Section 3.3.2.2.3 against the criteria in SRP-LR Section 3.3.2.2.3, which states that cracking due to stress corrosion cracking may occur in stainless steel diesel engine exhaust piping, piping component and piping elements exposed to diesel exhaust. The GALL Report, under Item VII.H2-1 recommends that a plant-specific program be credited to manage this aging effect for stainless steel piping, piping components and piping elements in the Auxiliary Systems.

The staff confirmed that only expansion joints that align to GALL AMRs VII.H2-1 for the Emergency Diesel Generators and Auxiliary System and the Station Blackout and UPS Diesel Generator System that are fabricated from stainless steel materials are applicable to TMI that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff noted that the applicant's proposed program will supplement its period visual inspections with volumetric testing to specifically manage cracking due to stress corrosion cracking in stainless steel components for indications of degradation. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections and volumetric testing for stainless steel to detect cracking due to stress corrosion cracking that could result in a loss of the component's intended function. The staff further noted that volumetric testing to detect cracking due to stress corrosion cracking is consistent with the inspection techniques recommended by the GALL AMP XI.M32 "One-Time Inspection," to detect the aging effect of cracking due to stress corrosion cracking. The staff finds that the applicant's use of volumetric testing to be consistent with the inspection techniques recommended by the GALL Report to detect this aging effect. The staff finds that this program includes activities that are consistent with the recommendations in the GALL Report, and that it is adequate to manage cracking due to stress corrosion cracking in stainless steel diesel exhaust piping, piping components and piping elements exposed to diesel exhaust on the internal surface.

Based on a review of the programs identified above, the staff concludes that the applicant's program meets SRP-LR Section 3.3.2.2.3. For those line items that apply to LRA Section 3.3.2.2.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.4 Cracking due to SCC and Cyclic Loading

The staff reviewed LRA Section 3.3.2.2.4 against the criteria in SRP-LR Section 3.3.2.2.4.

(1) LRA Section 3.3.2.2.4 refers to LRA Table 3.3.1, line item 7, and addresses cracking due to stress corrosion cracking and cyclic loading in stainless steel PWR non-regenerative heat exchanger components exposed to treated borated water greater than 60 °C (greater

than 140 °F) in the chemical and volume control system. The applicant stated that the component, material, environment, and aging effect/mechanism does not apply to auxiliary systems.

The staff reviewed LRA Section 3.3.2.2.4 against the criteria in SRP-LR Section 3.3.2.2.4, which states that cracking due to SCC and cyclic loading may occur in stainless steel PWR non-regenerative heat exchanger components exposed to treated borated water greater than 140 °F in the CVCS. The existing AMP monitors and controls primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading; therefore, the effectiveness of water chemistry control programs should be verified to ensure that cracking does not occur. The GALL Report recommends that a plant-specific AMP be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are adequately managed. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water and eddy current testing of tubes.

SRP-LR Section 3.3.2.2.4.1 invokes AMR Item 7 in Table 3 of the GALL Report, Volume 1, and AMR Item VII.E1-9 in the GALL Report, Volume 2, as applicable to stainless steel PWR non-regenerative heat exchanger components exposed to treated borated water greater than 140 °F.

In RAI AMR-Generic-2, dated January 5, 2009, the staff requested that the applicant provide additional information to justify why LRA Table 3.3.1, Item 3.3.1-7 is not applicable.

In its response to the RAI dated January 12, 2009, the applicant stated that this line item is from GALL Section VII.E1 for PWR Chemical and Volume Control system stainless steel non-regenerative heat exchangers exposed to borated treated water environment greater than 140 °F. The applicant indicated that this GALL system has been included in the TMI-1 makeup and purification license renewal system. The applicant further stated that the subject heat exchangers are the letdown coolers and the RC pump seal coolers and the LRA treated water environment greater than 140 °F should have been applied to these components.

The applicant revised LRA Section 3.3.2.2.4.1 to state the following:

> TMI-1 will implement a One-Time Inspection program, B.2.1.18, to verify the effectiveness of the Water Chemistry program, B.2.1.2, to manage cracking due to stress corrosion cracking in stainless steel PWR non-regenerative heat exchanger components exposed to treated borated water greater than 140 °F in the closed cycle cooling water system. Cracking due to cyclic loading does not apply since these components are continuously in service and not subject to cyclic loading. The GALL recommended verification program for temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes for managing cyclic loading is therefore not applicable. The Water Chemistry and One-Time Inspection programs are described in Appendix B.

The applicant also revised the discussion column in LRA Table 3.3.1, line item 3.3.1-7 to state the following:

> Not consistent with NUREG-1801. The One-Time Inspection program, B.2.1.18, will be used to verify the effectiveness of the Water Chemistry program, B.2.1.2, to

manage cracking due to stress corrosion cracking in stainless steel nonregenerative heat exchanged components exposed to treated borated water greater than 60 °C (greater than 140 °F). Cracking due to cyclic loading does not apply since these components are continuously in service and not subject to cyclic loading.

The applicant included four additional line items in LRA Table 3.3.2-4, closed-cycle cooling water system to address these heat exchanger components as follows (columns 1 to 9, from left to right respectively):

(1) Heat exchange components (letdown Coolers); Pressure Boundary; Stainless Steel; Treated Water (Internal) greater than 140 °F; Cracking/Stress Corrosion Cracking; One-Time Inspection (B.2.1.18); VII.E1-9; 3.3.1-7; and, I, 5.

(2) Heat exchange components (letdown Coolers); Pressure Boundary; Stainless Steel; Treated Water (Internal) greater than 140 °F; Cracking/Stress Corrosion Cracking; Water Chemistry (B.2.1.2); VII.E1-9; 3.3.1-7; and, I, 5.

(3) Heat exchange components (RC Pump Seal Return Coolers); Pressure Boundary; Stainless Steel; Treated Water (Internal) greater than 140 °F; Cracking/Stress Corrosion Cracking; One-Time Inspection (B.2.1.18); VII.E1-9; 3.3.1-7; and, I, 5.

(4) Heat exchange components (RC Pump Seal Return Coolers); Pressure Boundary; Stainless Steel; Treated Water (Internal) greater than 140 °F; Cracking/Stress Corrosion Cracking; Water Chemistry (B.2.1.2); VII.E1-9; 3.3.1-7; and, I, 5.

The staff reviewed the Water Chemistry Program, which is consistent with GALL AMP XI.M2, "Water Chemistry," and is also consistent with EPRI 1002884, "Pressurized Water Reactor Primary Chemistry Guidelines," Revision 5 and Plant TS limits for fluorides, chlorides, and dissolved oxygen. The staff also reviewed the One-Time Inspection Program, which is consistent with GALL AMP XI.M32, "One-Time Inspection," and uses enhanced VT-3 as recommended by GALL AMP XI.M32 to detect cracking. The staff's evaluation is of the Water Chemistry Program and the One-Time Inspection Program is documented in SER Sections 3.0.3.2.2 and 3.0.3.2.14 respectively. The staff determined that since these components are in continuous service and not subject to cyclic loading, cracking due to cyclic loading is not an applicable aging effect for these components.

The staff noted that GALL Report item V.D1-31 in PWR emergency core cooling system recommends Water Chemistry Program by itself to manage the aging effect of cracking due to stress corrosion cracking for stainless steel piping, piping components, and piping elements in an environment of treated borated water greater than 140 °F. The applicant is proposing the use of the One-Time Inspection program to verify the effectiveness of the Water Chemistry program. Therefore, on the basis that the applicant is verifying the effectiveness of the Water Chemistry Program, which beyond the recommendations of the GALL Report to use only the Water Chemistry program, the staff finds the combination of Water Chemistry program and the One-Time Inspection program will adequately manage the aging effects of cracking due to stress corrosion cracking in stainless steel PWR non-regenerative heat exchanger components exposed to treated borated water greater than 140 °F in the chemical and volume control system.

(2) LRA Section 3.3.2.2.4 refers to LRA Table 3.3.1, line item 8, and addresses cracking due to stress corrosion cracking and cyclic loading in stainless steel PWR non-regenerative heat exchanger components exposed to treated borated water greater than 60 °C (greater than 140 °F). The applicant stated that the component, material, environment, and aging effect/mechanism does not apply to auxiliary systems.

SRP-LR Section 3.3.2.2.4 states that cracking due to SCC and cyclic loading may occur in stainless steel PWR regenerative heat exchanger components exposed to treated borated water greater than 60 °C (140 °F).

The staff reviewed LRA Section 3.3.2.2.4 against the criteria in SRP-LR Section 3.3.2.2.4, which states that cracking due to SCC and cyclic loading may occur in stainless steel PWR regenerative heat exchanger components exposed to treated borated water greater than 140 °F. The existing AMP monitors and controls primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading; therefore, the effectiveness of water chemistry control programs should be verified to ensure that cracking does not occur. The GALL Report recommends that a plant-specific AMP be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are adequately managed.

SRP-LR Section 3.3.2.2.4 invokes AMR Item 8 in Table 3 of the GALL Report, Volume 1, and AMR Item VII.E1-5 in the GALL Report, Volume 2, as applicable to stainless steel PWR regenerative heat exchanger components exposed to treated borated water greater than 140 °F.

In RAI AMR-Generic-2, dated January 5, 2009, the staff requested that the applicant provide additional information to justify why LRA Table 3.3.1, line item 3.3.1-8 is not applicable.

In its response to the RAI dated January 12, 2009, the applicant stated there are no stainless steel regenerative heat exchanger components exposed to treated borated water greater than 60 °C (greater than 140 °F) in auxiliary systems and that the TMI-1 design does not include regenerative heat exchangers. Based on its review of the LRA, the staff confirmed that there are no stainless steel regenerative heat exchanger components exposed to treated borated water greater than 60 °C (greater than 140 °F) in auxiliary systems and that the TMI-1 design does not include regenerative heat exchangers. The staff finds the applicant's determination acceptable.

(3) LRA Section 3.3.2.2.4 refers to LRA Table 3.3.1, line item 9, and addresses cracking due to stress corrosion cracking and cyclic loading in stainless steel pump casings for the PWR high pressure pumps in the chemical and volume control system. The applicant stated that the component, material, environment, and aging effect/mechanism does not apply to auxiliary systems.

SRP-LR Section 3.3.2.2.4 states that cracking due to SCC and cyclic loading may occur in the stainless steel pump casing for the PWR high-pressure pumps in the chemical and volume control system.

In RAI AMR-GENERIC-2, dated January 5, 2009, the staff requested that the applicant provide additional information to justify why LRA Table 3.3.1, line item 3.3.1-9 is not applicable.

In its response to the RAI dated January 12, 2009, the applicant stated that this particular component, material, environment, and aging effect/mechanism combination does not exist. The applicant also stated that this line item is from GALL Section VII.E1 for PWR Chemical and Volume Control System stainless steel high pressure pumps and that this GALL system has been included in the TMI-1 makeup and purification (MUP) license renewal system. The applicant also stated that the subject pumps are the MU-P-1A/B/C make-up and purification pumps and that the components are not subject to a treated water environment greater than 140 °F so cracking due to SSC does not apply. The applicant also stated that cracking due to cyclic loading does not apply since these components are continuously in service and not subject to cyclic loading. Based on its review of the LRA, the staff confirmed that this GALL system has been included in the TMI-1 makeup and purification license renewal system. The staff also confirmed that the subject pumps are the MU-P-1A/B/C make-up and purification pumps and that the components are not subject to a treated water environment greater than 140 °F. The staff also confirmed that that cracking due to cyclic loading does not apply since these components are continuously in service and not subject to cyclic loading. The staff finds the applicant's determination acceptable.

(4) LRA Section 3.3.2.2.4 refers to LRA Table 3.3.1, line item 10, and addresses cracking due to stress corrosion cracking and cyclic loading in high strength steel closure bolting exposed to air with steam or water leakage. The applicant stated that the component, material, environment, and aging effect/mechanism does not apply to auxiliary systems.

The applicant manages the cracking of high strength bolting with the Bolting Integrity Program which is discussed in SER Section 3.0.3.1.3. The applicant's Bolting Integrity Program follows the guidelines of EPRI NP-5769, "Degradation and Failure of Bolting in Nuclear Power Plants," in its selection of bolting material and the use of lubricants and sealants. Additionally, the program follows the guidelines of NUREG-1339, "Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants," to prevent or mitigate degradation and failure of safety-related bolting, including the verification of gasket compression, and application of an appropriate preload. The staff finds this acceptable because it is in agreement with the GALL recommendations for the Bolting Integrity Program.

In RAI AMR-GENERIC-2, dated January 5, 2009, the staff requested that the applicant provide additional information to justify why LRA Table 3.3.1, Item# 3.3.1-10 is not applicable.

In its response to the RAI dated January 12, 2009, the applicant stated that there is no high-strength steel closure bolting exposed to air with steam or water leakage in auxiliary systems. Based on its review of the LRA, the staff confirmed that that there is no high-strength steel closure bolting exposed to air with steam or water leakage in auxiliary systems, and therefore, the staff finds the applicant's determination acceptable.

Based on a review of the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.4 criteria. For those line items that apply to LRA Section 3.3.2.2.4, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.5 Hardening and Loss of Strength due to Elastomer Degradation

(1) LRA Section 3.3.2.2.5 states that TMI-1 will credit the External Surfaces Monitoring Program to manage hardening and loss of strength due to elastomer degradation of elastomer hoses exposed to indoor air, air with borated water leakage, and dry air in the auxiliary steam system, emergency diesel generators and auxiliary systems, instrument and control air system, reactor coolant system, and station blackout and UPS diesel generator systems. The applicant further stated that the External Surfaces Monitoring Program consists of system inspections and walkdowns, and includes periodic visual inspections of elastomer hoses within the scope of license renewal and subject to an AMR in order to manage aging effects. The applicant also stated that the program manages aging effects through visual inspection of elastomer surfaces for evidence of elastomer degradation.

LRA Section 3.3.2.2.5 also states that TMI-1 will implement Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program to manage hardening and loss of strength due to elastomer degradation of elastomer expansion joints exposed to indoor air and wetted air in the auxiliary and fuel handling building ventilation systems, control building ventilation system, diesel generator building ventilation system, intake screen and pump house ventilation system, intermediate building ventilation system, and primary containment heating and ventilation system.

The applicant further stated that these internal inspections are performed during the periodic system and component surveillances or during the performance of maintenance activities when the surfaces are made accessible for visual inspection.

The staff reviewed LRA Section 3.3.2.2.5 against the criteria in SRP-LR Section 3.3.2.2.5, which states that hardening and loss of strength due to elastomer degradation may occur in elastomeric seals and components associated with auxiliary heating and ventilation systems that are exposed either internally or externally to uncontrolled indoor air. The SRP-LR recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed.

SRP-LR Section 3.3.2.2.5 invokes AMR Item 11 in Table 3 of the GALL Report, Volume 1, and AMR Items VII.F1-7, VII.F2-7, VII.F3-7 and VII.F4-6 in the GALL Report, Volume 2, as applicable to elastomeric seals and components in control room, auxiliary and radwaste, primary containment, and diesel generator building heating and ventilation systems that are exposed either internally or externally to uncontrolled indoor air.

The staff reviewed the External Surface Monitoring Program and finds that the program provides for management of aging effects through visual inspection of external surfaces for evidence hardening and loss of strength and loss of material. The applicant stated that visual inspections will be augmented by physical manipulation to detect hardening and loss of strength of elastomers. The staff determined that additional information was required in order to complete its review. In part 2 of RAI B.2.1.21-1, dated September 29, 2008, the staff requested that the applicant provide additional information to justify the basis for including elastomers in the scope of the External Surfaces Monitoring Program, to explain how the program will adequately manage the aging effects of hardening and loss of strength as it applies to the additional non-metallic components added to the scope of the program, and to describe the specific inspection techniques that will be used to detect the applicable aging effects for elastomers and clarify the acceptance criteria that will be used for these inspection techniques.

In its response to the RAI dated October 20, 2008, the applicant stated that the visual inspection will look for cracking and flaking. The applicant further stated that a resiliency test will be performed by compressing the material and observing a return to the original shape. The staff reviewed the External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.16. The staff finds the External Surface Monitoring Program acceptable because visual inspections of external surfaces for cracking and flaking will be performed periodically and physical manipulation of the elastomeric components will be performed, including a resiliency test, to detect the aging effects of hardening and loss of strength.

Based on its review, the staff finds the applicant's response to RAI B.2.1.21-1 acceptable because a visual inspection will be conducted that will look for cracking and flaking and a resiliency test will also be conducted by compressing the material and observing a return to the original shape. The staff's concern described in part 2 of RAI B.2.1.21-1 is resolved.

The staff reviewed the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program and finds that it requires periodic visual inspections of internal surfaces during periodic maintenance, predictive maintenance, surveillance testing, and corrective maintenance to detect aging effects that could result in a loss of component intended function. The applicant stated that in addition to visual inspection, physical manipulation will be used to detect hardening and loss of strength of elastomers both internally and externally. The staff's review of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program acceptable because visual inspections of internal surfaces for cracking and flaking will be performed periodically and physical manipulation of the elastomeric components, including a resiliency test, will be performed to detect the aging effects of hardening and loss of strength.

(2) LRA Section 3.3.2.2.5 states that TMI-1 will credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program to manage hardening and loss of strength due to elastomer degradation of elastomer hoses exposed to treated water in the auxiliary steam system. The applicant stated that these internal inspections are performed during the periodic system and component surveillances or during the performance of maintenance activities when the surfaces are made accessible for visual inspection.

The staff reviewed LRA Section 3.3.2.2.5 against the criteria in SRP-LR Section 3.3.2.2.5, which states that hardening and loss of strength due to elastomer degradation may occur in elastomer linings of the filters, valves, and ion exchangers in spent fuel pool cooling and cleanup systems (BWR and PWR) exposed to treated water or to treated borated water. The GALL Report recommends that a plant-specific aging management program be evaluated to determine and assess the qualified life of the linings in the environment to ensure that these aging effects are adequately managed.

SRP-LR Section 3.3.2.2.5 invokes AMR Item 12 in Table 3 of the GALL Report, Volume 1, and AMR Item VII.A3-1 in the GALL Report, Volume 2, as applicable to elastomeric linings in PWR spent fuel pool cooling and cleanup systems that are exposed to treated borated water.

The staff reviewed the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program and finds that it performs periodic visual inspections of internal surfaces during periodic maintenance, predictive maintenance, surveillance testing, and corrective maintenance to detect aging effects that could result in a loss of component intended function. The applicant stated that in addition to visual inspection, physical manipulation may be used to detect hardening and loss of strength of elastomers both internally and externally. The staff determined that additional information was required in order to complete its review. In part 2 of RAI B.2.1.22-1, dated September 29, 2008, the staff requested that the applicant provide additional information to justify the basis for including neoprene and rubber in the scope of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, explain how this program will adequately manage the aging effects of hardening and loss of strength as it applies to the additional non-metallic components added to the scope of the program, describe the specific inspection techniques that will be used to detect the applicable aging effects for elastomers, and clarify the acceptance criteria that will be used for these inspection techniques.

In its response to the RAI dated October 20, 2008, the applicant stated that the visual inspection will look for cracking and flaking. The applicant further stated that a resiliency test will also be performed by compressing the material and observing a return to the original shape. The staff reviewed the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program acceptable because visual inspections of internal surfaces for cracking and flaking will be performed periodically and physical manipulation of the elastomeric components, including a resiliency test, will be performed to detect the aging effects of hardening and loss of strength.

Based on its review, the staff finds the applicant's response to RAI B.2.1.22-1 acceptable because a visual inspection will be conducted that will look for cracking and flaking and a resiliency test will also be conducted by compressing the material and observing a return to the original shape. The staff's concern described in part 2 of RAI B.2.1.22-1 is resolved.

Based on a review of the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.5 criteria. For those line items that apply to LRA Section 3.3.2.2.5, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

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

The staff reviewed LRA Section 3.3.2.2.6 against the criteria in SRP-LR Section 3.3.2.2.6.

LRA Section 3.3.2.2.6 describes the program to manage the loss of material and the rationale for not requiring a neutron-absorbing capacity aging management program as follows:

> Reduction of neutron-absorbing capacity and loss of material due to general corrosion could occur in the neutron-absorbing sheets of BWR and PWR spent fuel storage racks exposed to treated water or to treated borated water. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).
>
> TMI-1 will implement a Water Chemistry program, B.2.1.2, to manage loss of material due to general corrosion of the Boral, boron steel spent fuel storage racks neutron-absorbing sheets exposed to treated water in the fuel handling and fuel storage system. The Water Chemistry Program consists of measures that are used to manage aging of piping, piping components, piping elements and heat exchangers and mitigate damage caused by corrosion and stress corrosion cracking (SCC). The Water Chemistry Program relies on monitoring and control of reactor water chemistry based on industry guidelines for primary water and secondary water chemistry such as EPRI TR-105714, Rev. 3 and TR-102134, Rev. 3 or later revisions. The Water Chemistry Program is described in Appendix B.
>
> Reduction of neutron-absorbing capacity of the Boral, boron steel spent fuel storage racks neutron-absorbing sheets exposed to treated water is insignificant and requires no aging management. The potential for aging effects due to sustained irradiation of Boral was previously evaluated by the staff (BNL-NUREG-25582, dated January 1979; NUREG-1787, VC Summer SER, paragraph 3.5.2.4.2, page 3-406) and determined to be insignificant. Plant operating experience with Boral coupons inspected in 1995, 1997, 1999, and 2001 is consistent with the staff's conclusion and an aging management program is not required.

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information in LRA Section 3.3.2.2.6 on the applicant's management of the loss of material to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation. The staff also reviewed the rationale for not requiring a neutron-absorbing capacity aging management program.

The staff reviewed LRA Section 3.3.2.2.6 against the staff's recommended regulatory criteria in SRP-LR Section 3.3.2.2.6 and in GALL AMR Item VII.A2-5 of the GALL Report, Volume 2.

The staff questioned that the rationale provided by the applicant for not requiring an aging management program for the neutron-absorbing capacity was adequate. After teleconferences with the applicant, the staff noted that TMI-1 does have a Boral Surveillance Program in place. The staff also required more information about the details of the Water Chemistry Program's management of the loss of material due to the general corrosion of Boral. In RAI 3.3.2.2.6-1, dated October 20, 2008, the staff requested that the applicant provide additional information concerning the details of the Boral Surveillance Program and the Water Chemistry Program.

In its response to the RAI dated November 12, 2008, the applicant provided information on the Boral Surveillance Program, relevant operating experience, and the Water Chemistry Program. Also, the applicant made the following commitment: "Boral test coupon surveillance will continue through the period of extended operation."

The applicant responded with more details on the method of testing in the Boral Surveillance Program by stating:

> The TMI-1 Boral test coupon surveillance program directs coupon testing in accordance with the spent fuel rack manufacturer's recommendations. The coupon is removed from the test coupon tree located in the spent fuel pool and is shipped to a contractor measurement laboratory. The measurement laboratory characterizes the test coupon in conformance with the rack manufacturer's procedure. Inspection of the test coupon includes visual observation and photography, dimensional measurements, weight and density/specific gravity, and neutron attenuation. The coupon is visually examined to detect pitting, swelling, or other degradation. The coupon may be photographed if, in the judgment of the technician, there is any information of significance that should be photographically documented. Length and width of the coupon are measured at multiple locations (three each per coupon) for comparison to the original (pre-irradiated) dimensions. Thickness of the coupon is measured at multiple locations (five per coupon) for comparison to the original dimensions. Coupon weight and density/specific gravity are measured and calculated. Neutron attenuation is measured using a collimated thermal neutron beam. The counting intervals used are sufficient to assure the standard error due to counting statistics is essentially negligible (<0.15%) at the lowest counting rate.

The staff has reviewed the testing aspects of the program and has found them to be acceptable since there is extensive testing that would ensure that degradation of the coupons would be detected. Also, the measurements of neutron attenuation, physical distortion, and weight change would precede a loss of functionality in the Boral panels, and by performing these measurements, the program provides assurance that degradation would be detected before loss of functionality.

The applicant responded with details on the Boral coupons used by stating:

> Two coupon sample trees are located in the TMI-1 spent fuel pool. A total of fourteen sample coupons remain. At the nominal rate of one coupon sampled every five years, a more than sufficient number of coupons remains to maintain the sampling frequency through the period of extended operation.
>
> - Upon installation in 1992 of the high density fuel storage racks containing the Boral absorber material, one coupon tree, intended for long-term testing, was located in the spent fuel pool in a manner such that it was surrounded by freshly discharged spent fuel assemblies. The second coupon tree was intended for accelerated exposure. This tree was located such that it was surrounded by hot, freshly discharged fuel for each of the first five cycles following installation of the racks containing Boral. This coupon tree has remained in the last location following the fifth cycle discharge. This sample location strategy meets the recommendations from the rack manufacturer.
>
> - The Boral sample coupons are encased in stainless steel jackets of an alloy identical to that used in the storage racks, formed so as to encase the Boral and fix

it in position with tolerances similar to those for the storage racks. The Boral coupon specimens are fully exposed to the pool water, as are the Boral absorber panels in the vented storage racks.

- The coupon is visually examined to detect pitting, swelling, or other degradation such as blistering. The coupon may be photographed if, in the judgment of the technician, there is any information of significance that should be photographically documented. Areal density is determined from neutron attenuation, which is measured using a collimated thermal neutron beam. The counting intervals used are sufficient to assure the standard error due to counting statistics is essentially negligible (<0.15%) at the lowest counting rate. A collimated beam of thermalized neutrons is passed through the sample in a perpendicular direction. The number of neutrons emerging is counted with a neutron detector. By comparing the counting rate for the surveillance sample with a corresponding rate from a standard sample, the relative transmission is determined.
- To date, TMI-1 has not reinserted test coupons into the spent fuel pool following their removal and inspection.

The staff has reviewed the details on the Boral coupons and has found it to be acceptable since there are a sufficient number of coupons to ensure that testing will be able to continue through the period of extended operation, and the staff considers the program to collect data from representative coupon samples to assess for stability and integrity of Boral to be acceptable for detection of aging effects.

The applicant provided details on how the Boral would be monitored and trended by stating:

> Monitoring of the Boral neutron absorber is accomplished through periodic examination of the Boral test coupons, consisting of visual observations (which may include photography), dimensional measurements (length, width, and thickness), weight and density determinations, and neutron attenuation measurements (for B-10 areal density). Results are compared to archive values from pre-irradiated samples, and with results from previous coupon examinations, summarized in reports of the surveillance compiled by the measurement laboratory and forwarded to TMI-1 Reactor Engineering for review. The results are evaluated against acceptance criteria for determination of any follow-up activities as appropriate (e.g., removal and examination of additional coupons, wet chemical analyses, radiography, etc.). The evaluation reports of the coupon examinations are maintained to provide a continuing source of data for trend analysis.

The staff has reviewed the program details regarding the monitoring and trending of Boral and has found it to be acceptable since the applicant monitors and trends the appropriate parameters to identify appropriate follow-up activities.

The applicant provided details on the acceptance criterion and corrective actions of the Boral Surveillance Program by stating:

> Acceptance criteria of the TMI-1 Boral surveillance program are as follows:
>
> - A decrease of no more than 5% in Boron-10 content as determined by neutron attenuation measurements.

- An increase in thickness at any point should not exceed 10% of the initial thickness at that point.

The Boral test coupon surveillance program was established to monitor the integrity and performance of Boral on a continuing basis and to assure that any slowly developing or long-term effects, if any, do not become significant. The surveillance program is intended to detect the onset of any significant degradation with ample time to take corrective action as may be necessary.

Changes in excess of either of the acceptance criteria require investigation and engineering evaluation as directed by TMI-1 Reactor Engineering. Based on the results of the engineering evaluation, additional activities may be determined to be appropriate. These additional activities may include:

- Early retrieval and measurement of one or more of the remaining coupons to provide corroborative evidence that the measurements are real.
- Wet chemical analyses (destructive) and radiography (non-destructive) for confirming measurements.

If corroborated results of the test coupon surveillance program do not satisfy acceptance criteria, additional actions such as in situ radiography, or "blackness testing" of the spent fuel racks, may be employed to investigate the extent of degradation, if any, in the racks. In the event that any degradation of the Boral absorber in the spent fuel racks is detected, neutron radiographs of the suspected locations may be obtained. Positive confirmation of any defects will result in evaluations to assure that required subcriticality margin is maintained. Actions may include restrictions on rack cell use, repair of the cell to restore absorber effectiveness, or installation of new racks.

The staff has reviewed the acceptance criterion and corrective actions and has found it to be acceptable since the acceptance criterion will provide assurance that corrective actions could be taken before loss of functionality would occur.

The staff has reviewed the information provided by the applicant on the details of the Boral Surveillance Program. The staff has found the specific method of testing of the Boral coupons, monitoring and trending of the Boral condition, acceptance criteria, and corrective actions to be acceptable as stated previously.

In addition, the applicant provided information in the response to RAI 3.3.2.2.6-1 regarding relevant operating experience. The applicant stated the following:

The Seabrook operating experience report and subsequent Part 21 notification concerning bulging and blistering of a Boral surveillance coupon has had no impact on the TMI-1 Boral test coupon surveillance program in that the existing TMI-1 program continues as planned, with removal of test coupons for examination by the measuring laboratory continuing as per the surveillance program. An Exelon evaluation of the Seabrook operating experience determined that Exelon fleet and industry Boral surveillance programs will continue to provide data that can be interpreted by company and support organizations to determine if further action is required.

Blisters are characterized by a local area where the Boral aluminum cladding separates from the aluminum and boron carbide core and the clad is plastically deformed outward away from the core. Water intrusion into the aluminum and boron carbide core of the Boral material may occur through small voids present in the core due to the manufacturing process, and can react with the aluminum powder to form aluminum oxide and hydrogen. The appearance of blisters suggests their mechanism of formation is related to a local pressure buildup in the core causing clad/core delamination and subsequent local plastic deformation of the aluminum cladding. Neutron attenuation tests have confirmed that blisters have not altered the neutron absorption properties of the Boral material. However, blister formation has the potential to displace water from the flux trap region of the TMI-1 Region 1 fuel racks, and blister formation occurring in the TMI-1 Region 2 fuel racks has the potential to deform the sheathing material which may cause a reduction of clearance in the fuel storage cell.

In the TMI-1 Region 1 fuel storage racks, water in the flux trap region between the fuel rack storage cells thermalizes neutrons, enhancing the neutron absorber effect. In the event that a blister does not fill with water (whose intrusion into the Boral core resulted in the hydrogen generation that formed the blister), blister formation in the Boral absorber panels in the Region 1 fuel racks can displace water in the flux trap region, and a localized increase in reactivity (at the blister location) could result.

In the TMI-1 Region 2 fuel storage racks, Boral blister formation sufficient to deform the stainless steel sheathing material could cause a reduction of clearance in the affected storage location. Should blisters occur in more than one Boral panel adjacent to a single cell, and at a coincident axial elevation, the condition could become acute enough to make fuel assembly insertion or removal in that cell difficult. The TMI-1 Region 2 fuel storage rack design, however, reduces this potential due to use of a sheathing material thickness greater than the typical sheathing thickness (and, for example, greater than the sheathing thickness in the TMI-1 Region 1 storage racks, which due to the storage rack design are not subject to cell clearance reduction due to sheathing deformation). Since resistance to sheathing displacement is increased, a subsequent decrease of clearance in the cell is less likely than in a storage rack design that uses thinner sheathing material.

These effects are not safety concerns at TMI-1 since continuation of the TMI-1 Boral test coupon surveillance program through the period of extended operation, as well as monitoring and evaluation of Exelon fleet and industry operational and testing experience, will allow the onset of any degradation in the Boral material to be detected early so that appropriate mitigation measures may be applied.

Bulging deformation of storage rack cells that had been observed in some early unvented rack designs was due to swelling of the unvented Boral storage pockets when hydrogen gas was generated during development of the protective oxide film on the aluminum surface of the Boral material when first immersed in the pool water. Subsequent rack designs, including TMI-1's storage racks, are of the vented design where any hydrogen that may be generated during the passivation process is permitted to escape the rack cell's Boral panel storage pocket.

Swelling was observed in early foreign applications of Boral in storage racks manufactured in the 1980s. The cause of swelling in these early panels was corrected in later production by instituting appropriate controls on the boron carbide chemical composition. The Holtec procured Boral panels utilized in TMI-1's storage racks were manufactured under quality assurance/quality control programs that conform to the requirements of 10 CFR 50 Appendix B. These Boral panels have performed well in the industry in part as a result of the development of a Holtec procurement specification for Boral, which imposed stricter controls on the manufacturing process and amounts of key materials.

Generalized corrosion and localized pitting corrosion of the aluminum cladding material of the Boral panels can occur in the spent fuel pool environment. However, in the boric acid solution typical of TMI-1 and other PWR spent fuel pools, generalized corrosion does not occur. The EPRI Handbook of Neutron Absorber Materials for Spent Nuclear Fuel Transportation and Storage, 2006 Edition, has reported that localized pitting has been observed in test specimens. Causes were determined to be the presence of corrosion occurring along the boundaries of long thin grains along the edge of the Boral material caused by the rolling processing, impurities in the aluminum powder and boron carbide used to manufacture the core matrix, and incomplete cleaning of metallurgical oils used in the rolling process. These corrosion degradations have not resulted in any decrease in Boron-10 areal density, and consequently have not diminished the Boral material's effectiveness in neutron absorption.

These effects are, not safety concerns at TMI-1 since continuation of the TMI-1 Boral test coupon surveillance program through the period of extended operation, as well as monitoring and evaluation of Exelon fleet and industry operational and testing experience, will allow the onset of any degradation in the Boral material to be detected early so that appropriate mitigation measures may be applied.

The staff has reviewed and confirmed the operating experience and the staff finds this acceptable since the operating experience supports the conclusion that the implementation of the Boral Surveillance Program will continue to be able to manage the loss of neutron-absorbing capacity and degradation of Boral effectively.

The applicant in response to the Water Chemistry part of RAI 3.3.2.2.6-1 has stated:

The Water Chemistry program manages loss of material due to general corrosion of the aluminum cladding of the Boral material by controlling and monitoring the spent fuel pool water chemistry. The boric acid solution concentration in the spent fuel pool water inventory is maintained at a goal level to assure that loss of material due to general corrosion of the aluminum cladding of the Boral material is adequately managed. The spent fuel pool water inventory is sampled and analyzed for Boron on a frequency of at least once per seven days. The goal concentration for Boron in the spent fuel pool water inventory is greater than or equal to 2500 ppm, and less than 5000 ppm. If the Boron concentration is found to be less than the minimum goal value, plant Operations, and Chemistry Supervision are to be immediately notified, with actions initiated to return the parameter to the specified range. Per the EPRI Handbook of Neutron Absorber Materials for Spent Nuclear Fuel Transportation and Storage, 2006 Edition, in a 2500 ppm boric aid solution, generalized corrosion of aluminum does not occur.

In addition to Boron, the spent fuel pool water inventory is sampled and analyzed for parameters including pH, Chloride, Fluoride, Sulfate, Silica, Aluminum, Calcium, Magnesium, and others. More details on the Water Chemistry program, B.2.1.2, are available in the TMI-1 LRA in Appendix B.

The staff has reviewed the Water Chemistry Program response from the applicant and finds that the response provides adequate assurance that the program will be able to adequately manage the loss of material from the general corrosion of Boral since the program has controls to ensure that the correct boron concentration is in the pool.

The staff reviewed the applicant's response and finds that it adequately explains that through the use of the Boral Surveillance Program, the reduction of neutron absorption capacity aging effect, will be adequately managed for the period of extended operation. Additionally, the staff finds that the applicant's Water Chemistry Program will adequately manage the aging effect of loss of material because the program has controls to ensure the correct boron concentration in the pool. The staff's concern described in RAI 3.3.2.2.6-1 is resolved.

In response to RAI 3.3.2.2.6-1, the applicant made an addition to the Appendix A, A.5 License Renewal Commitment List. There, the applicant makes the commitment that the "Boral test coupon surveillance will continue through the period of extended operation." This is found to be acceptable by the staff since it gives assurance that the neutron-absorbing capacity will be adequately managed in the period of extended operation.

On the basis of its technical review of the applicant's Boral Surveillance Program and Water Chemistry Program, the staff concludes that the applicant has demonstrated that effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the commitment and concludes that it provides adequate assurance that the program will be maintained in the period of license extension.

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

The staff reviewed LRA Section 3.3.2.2.7 against the criteria in SRP-LR Section 3.3.2.2.7.

(1) LRA Section 3.3.2.2.7 refers to LRA Table 3.3.1, line items 14, 15, and 16, and addresses loss of material due to general, pitting, and crevice corrosion for steel piping, piping components, and piping elements exposed to lubricating oil; for steel reactor coolant pump oil collection system piping, tubing, and valve bodies exposed to lubricating oil; and for steel reactor coolant pump oil collection system tank exposed to lubricating oil. The applicant stated that the component, material, environment, and aging effect/mechanism does not apply to auxiliary systems.

SRP-LR Section 3.3.2.2.7 states that loss of material due to general, pitting, and crevice corrosion may occur in steel piping, piping components, and piping elements, including the tubing, valves, and tanks in the reactor coolant pump oil collection system, exposed to lubricating oil (as part of the fire protection system).

In RAI AMR-Generic-2, dated January 5, 2009, the staff requested that the applicant provide additional information to justify why LRA Table 3.3.1, Items 3.3.1-14, 15, and 16 are not applicable.

In its response to the RAI dated January 12, 2009, the applicant stated the following:

Item 3.3.1-14: TMI-1 predicts the additional aging effect/mechanism of loss of material/MIC for carbon steel in lubricating oil. This component, material, environment, and aging effect/mechanism combination is addressed by item 3.4.1-12.

Item 3.3.1-15: Component/material combination does not exist in Auxiliary Systems. The TMI-1 reactor coolant pump lubricating oil collection components are stainless steel. Line item 3.3.1-33 addresses the stainless steel reactor coolant pump lubricating oil collection components. See LRA Section 3.3.2.2.12.2.

Item 3.3.1-16: Component/material combination does not exist in Auxiliary Systems. The TMI-1 reactor coolant pump lubricating oil collection components are stainless steel. Line item 3.3.1-33 addresses the stainless steel reactor coolant pump lubricating oil collection components. See LRA Section 3.3.2.2.12.2.

Based on its review of the LRA, the staff confirmed the following:

That TMI-1 predicts the additional aging effect/mechanism of loss of material/MIC for carbon steel in lubricating oil and that this component, material, environment, and aging effect/mechanism combination is addressed by item 3.4.1-12.

That the TMI-1 reactor coolant pump lubricating oil collection components are stainless steel and line item 3.3.1-33 addresses the stainless steel reactor coolant pump lubricating oil collection components.

The staff finds the applicant's determination acceptable.

(2) LRA Section 3.3.2.2.7 addresses loss of material due to general, pitting, and crevice corrosion, stating that this aging effect is not applicable to TMI-1, which is a PWR.

SRP-LR Section 3.3.2.2.7 states that loss of material due to general, pitting, and crevice corrosion may occur in steel piping, piping components, and piping elements in the BWR reactor water cleanup and shutdown cooling systems exposed to treated water.

TMI-1 is a PWR and does not have reactor water cleanup and shutdown cooling systems. On this basis, the staff finds that this item is not applicable to TMI-1.

(3) LRA Section 3.3.2.2.7 addresses loss of material due to general (steel only), pitting and crevice corrosion in steel and stainless steel diesel engine exhaust piping, piping components and piping elements exposed to diesel exhaust. The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will manage this aging effect in steel and stainless steel internal surfaces exposed to diesel exhaust. The staff reviewed LRA Section 3.3.2.2.7 against the criteria in SRP-LR Section 3.3.2.2.7, which states that loss of material due to general (steel only), pitting and crevice corrosion may occur in steel and stainless steel diesel engine exhaust piping, piping components and piping elements exposed to diesel exhaust.

The GALL Report, under Item VII.H2-2 recommends that a plant-specific program be credited to manage aging effect for steel and stainless steel piping, piping components and piping elements in the auxiliary systems.

The staff confirmed that only piping, fittings and expansion joints that align to GALL AMRs VII.H2-2 for the emergency diesel generators and auxiliary system and the station blackout and UPS diesel generator system that are fabricated from steel and stainless steel materials that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program are applicable to TMI-1.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are consistent with the recommendations in the GALL Report, and that it is adequate to manage loss of material due to general (steel only), pitting and crevice corrosion in steel and stainless steel diesel exhaust piping, piping components and piping elements exposed to diesel exhaust on the internal surface.

Based on a review of the program identified above, the staff concludes that the applicant's program meets SRP-LR Section 3.3.2.2.7 criteria. For those line items that apply to LRA Section 3.3.2.2.7, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.8 Loss of Material due to General, Pitting, Crevice, and MIC

The staff reviewed LRA Section 3.3.2.2.8 against the criteria in SRP-LR Section 3.3.2.2.8.

LRA Section 3.3.2.2.8 states that the Buried Piping and Tanks Inspection Program, will be implemented to manage the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion of the steel (with or without coating or wrapping) piping, piping components, piping elements, and structural members exposed to soil in the circulating water system, emergency diesel generators and auxiliaries system, fire protection system, instrument and control air system, open cycle cooling water system, primary containment heating and ventilation system, station blackout and UPS diesel generator systems, and dike/flood control system.

The staff reviewed LRA Section 3.3.2.2.8 against the criteria in SRP-LR Section 3.3.2.2.8, which states that states that loss of material due to general, pitting, crevice corrosion, and MIC could occur for steel (with or without coating or wrapping) piping, piping components, and piping elements buried in soil. The buried piping and tanks inspection program relies on industry practice, frequency of pipe excavation, and operating experience to manage the effects of loss of material from general, pitting, and crevice corrosion and MIC. The effectiveness of the buried piping and tanks inspection program should be verified to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

The staff reviewed the Buried Piping and Tanks Inspection Program and its evaluation is documented in SER Section 3.0.3.2.15. The staff finds that this program provides focused and opportunistic excavations and inspections for general, pitting, crevice, and microbiologically-influenced corrosion of buried steel piping and tanks within ten years before the period of extended operation and within ten years after the initiation of the period of operation except for the buried diesel generator fuel storage 30,000 gallon tank. The walls of this tank will be subjected to ultrasonic testing from the inside of tank to verify acceptable wall thickness. The operating experience regarding buried piping and tanks at TMI-1 did not indicate adverse trends of piping degradation. The results of focused and opportunistic inspection of buried piping and tanks will be evaluated and any degradation will be evaluated through the applicant's corrective action program where repair and replacement options and inspection frequency will be addressed. Therefore, the staff finds that, based on a review of the program identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.8.

Based on a review of the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.8 criteria. For those line items that apply to LRA Section 3.2.2.2.8, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.9 *Loss of Material due to General, Pitting, Crevice, MIC and Fouling*

The staff reviewed LRA Section 3.3.2.2.9 against the criteria in SRP-LR Section 3.3.2.2.9.

(1) LRA Section 3.3.2.2.9 states that the One-Time Inspection Program, will be implemented to verify the effectiveness of the Fuel Oil Chemistry Program to manage the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling of the steel piping, piping components, piping elements, and tanks exposed to fuel oil in the auxiliary steam system, emergency diesel generators and auxiliary systems, fuel oil system, and station blackout and UPS diesel systems.

The staff reviewed LRA Section 3.3.2.2.9 against the criteria in SRP-LR Section 3.3.2.2.9 which states that loss of material due to general, pitting, crevice, MIC, and fouling could occur for steel piping, piping components, piping elements, and tanks exposed to fuel oil. The existing aging management program relies on the fuel oil chemistry program for monitoring and control of fuel oil contamination to manage loss of material due to corrosion or fouling. Corrosion or fouling may occur at locations where contaminants accumulate. The effectiveness of the fuel oil chemistry control should be verified to ensure that corrosion is not occurring.

The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, crevice, MIC, and fouling to verify the effectiveness of the Fuel Oil Chemistry Program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff reviewed the Fuel Oil Chemistry Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.12 and 3.0.3.2.14 respectively. The staff finds that that these programs 1) provide for periodic sampling of fuel oil and periodic, draining, cleaning and visual inspection of fuel tanks to maintain contaminants at acceptable limits to preclude loss of material due to pitting and corrosion and 2) will require one-time inspection of select susceptible steel piping, piping components, piping elements, and tanks exposed to fuel oil for loss of material due to general, pitting, crevice and microbiologically-influenced corrosion and fouling to verify the effectiveness of the Fuel Oil Chemistry Program in applicable auxiliary systems. Therefore, the staff finds that, based on a review of the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.9.1.

(2) LRA Section 3.3.2.2.9 addresses loss of material due to general, pitting, crevice, microbiologically-influenced corrosion and fouling in steel piping, piping components and elements and tanks exposed to fuel oil. The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will manage this aging effect in steel internal surfaces exposed to internal fuel oil environment. The staff reviewed LRA Section 3.3.2.2.9 against the criteria in SRP-LR Section 3.3.2.2.9, which states that loss of material due to general, pitting, crevice, microbiologically-influenced corrosion and fouling may occur in steel piping, piping components and elements and tanks exposed to fuel oil. The GALL Report, under Item VII.H1-10 and VII.H2-24 recommends that the Fuel Oil Chemistry Program be credited to manage this aging effect and that a plant-specific AMP be evaluated and credited to verify that the Fuel Oil Chemistry Program is effective. These GALL AMRs identify a One-Time Inspection Program is an acceptable AMP to credit for the verification of the effectiveness of the Fuel Oil Chemistry Program.

The staff confirmed that only tanks, piping and fittings that align to GALL AMRs VII.H1-1 for the Emergency Diesel Generators and Auxiliary System and the Station Blackout and UPS Diesel Generator System that are fabricated from steel materials that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, are applicable to TMI-1.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities are adequate to manage loss of material due to general, pitting, crevice, microbiologically-influenced corrosion and fouling in steel piping, piping components, piping elements and tanks exposed to fuel oil on the internal surface.

(3) LRA Section 3.3.2.2.9 states that the One-Time Inspection Program, will be implemented to verify the effectiveness of the Lubricating Oil Analysis Program, to manage loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion of steel piping, piping components, and piping elements exposed to lubricating oil in the reactor coolant system. Fouling is not predicted for this component, material and environment combination.

The staff reviewed LRA Section 3.3.2.2.9 against the criteria in SRP-LR Section 3.3.2.2.9 which states that loss of material due to general, pitting, crevice, MIC, and fouling could occur for steel heat exchanger components exposed to lubricating oil. The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. The effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The applicant stated that fouling of steel piping, piping components, and piping elements exposed to a lubricating oil environment is not predicted. In RAI 3.3.1.21-1, dated October 16, 2008, the staff requested that the applicant provide additional information that demonstrates steel piping, piping components and piping elements are not subject to fouling when exposed to lubricating oil.

In its response to the RAI dated November 12, 2008, the applicant stated that the EPRI Report 1010639, "Non-Class 1 Mechanical Tools," Revision 4, Appendix C, Table 4-1 does not predict the fouling of steel piping when exposed to lubricating oil. The staff noted that citing the EPRI Report 1010639 alone did not provide sufficient information for the staff to complete its evaluation.

In RAI AMR-GENERIC-3, dated January 05, 2009, the staff requested that the applicant provide additional information stating the reason why fouling is not predicted for steel components in lubricating oil.

In response to the RAI dated January 12, 2009, the applicant stated that fouling is not predicted because microorganisms are not expected in lubricating oil because water contamination that is necessary to support microorganisms is not present in lubricating oil. The applicant further stated even if a fouling deposit caused the aging effect of loss of material, a one-time inspection for other aging mechanisms would manage fouling as well.

Based on its review, the staff finds the applicant's response to the RAI acceptable because loss of material due to fouling of steel piping and piping is not likely to occur because the water contamination necessary for microorganisms to cause fouling is not generally found in lubricating oil and if fouling is active in lubricating oil, a one-time inspection of select components will identify it.

The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and documents its review in SER Sections 3.0.3.2.18 and 3.0.3.2.14 respectively and found that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to general, pitting, crevice and microbiologically-influenced corrosion and fouling and 2) will require one-time inspection of select susceptible steel pump and valve components for loss of material due to general, pitting, crevice and microbiologically-influenced corrosion to verify the effectiveness of the Lubricating Oil Analysis Program in applicable auxiliary systems.

Based on a review of the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.9 criteria. For those line items that apply to LRA Section 3.3.2.2.9, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.10 Loss of Material due to Pitting and Crevice Corrosion

The staff reviewed LRA Section 3.3.2.2.10 against the criteria in SRP-LR Section 3.3.2.2.10.

(1) LRA Section 3.3.2.2.10 addresses loss of material due to pitting and crevice corrosion in steel piping with elastomer lining exposed to treated borated water, stating that this aging effect is not applicable to TMI-1 which is a PWR.

SRP-LR Section 3.3.2.2.10 states that loss of material due to pitting and crevice corrosion may occur in BWR and PWR steel piping with elastomer lining or stainless steel cladding that are exposed to treated water and treated borated water if the cladding or lining is degraded.

In RAI AMR-Generic-2, dated January 5, 2009, the staff requested that the applicant provide additional information to justify why LRA Table 3.3.1, line item 3.3.1-22 is not applicable.

In its response to the RAI dated January 12, 2009, the applicant stated the item is not applicable because there are no steel with elastomer lining or stainless steel cladding piping, piping components, and piping elements exposed to treated water and treated borated water in auxiliary systems.

The staff confirmed that there are no elastomer-lined steel components within the scope of license renewal for auxiliary systems. Based on this, the staff finds that the item does not apply to TMI-1.

(2) LRA Section 3.3.2.2.10 addresses the applicant's aging management basis for managing loss of material due to pitting and crevice corrosion in stainless steel and steel with stainless steel cladding heat exchanger components, tanks, penetration bellows, support members, and the fuel transfer canal liner, and in aluminum support members exposed to treated water in the closed-cycle cooling water system, the component supports commodities group, the fuel handling building, the miscellaneous floor and equipment drains system, and the reactor building. The applicant stated that the aging effect of loss of material due to pitting and crevice corrosion in these components will be managed by a combination of the Water Chemistry Program and the One-Time Inspection Program.

The staff reviewed LRA Section 3.3.2.2.10 against the criteria in SRP-LR Section 3.3.2.2.10, which states that loss of material due to pitting and crevice corrosion may occur in stainless steel and aluminum piping, piping components, piping elements, and in stainless steel and steel with stainless steel cladding heat exchanger components exposed to treated water. The SRP-LR states that the existing AMP monitors and controls reactor water chemistry to manage the aging effects of loss of material from pitting and crevice corrosion, but that high concentrations of impurities in crevices and with stagnant flow conditions may cause pitting or crevice corrosion; therefore, the effectiveness of water chemistry control programs should be verified to ensure that corrosion does not occur. The GALL Report recommends further evaluation of programs to manage loss of material from pitting and crevice corrosion to verify the effectiveness of water chemistry control programs. The SRP-LR states that a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds the applicant's Water Chemistry

Program, with an enhancement, is consistent with GALL AMP XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection Program and its evaluation is documented in SER Section 3.0.3.2.14. The staff finds that that the applicant's One-Time Inspection Program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence or note the absence of loss of material in susceptible locations due to pitting or crevice corrosion for components within the scope of the program. Based on the staff's determination that the applicant's Water Chemistry Program provides mitigation and the applicant's One-Time Inspection Program provides detection for the aging effect of loss of material due to pitting or crevice corrosion, the staff finds the applicant's proposed AMPs for managing the aging effect of loss of material due to pitting and crevice corrosion of the stainless steel and steel with stainless steel cladding heat exchanger components, tanks, penetration bellows, support members, fuel transfer canal liner, and aluminum support members exposed to treated water in the closed-cycle cooling water system, the component supports commodities group, the fuel handling building, the miscellaneous floor and equipment drains system, and the reactor building to be acceptable.

(3) LRA Section 3.3.2.2.10 addresses loss of material due to pitting and crevice corrosion in copper alloy HVAC piping, piping components and piping elements exposed to condensation. The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program or the External Surfaces Monitoring program will manage this aging effect in copper alloy internal surfaces or external surfaces, respectively, exposed to condensation (i.e. outdoor air, wetted air/gas and air with borated water leakage). The staff reviewed LRA Section 3.3.2.2.10 against the criteria in SRP-LR Section 3.3.2.2.10, which states that loss of material due to pitting and crevice corrosion may occur in copper alloy HVAC piping, piping components and piping elements exposed to condensation.

The GALL Report, under Items VII.F1-16, VII.F2-14, VII.F3-16 and VII.F4-12 and SRP-LR Section 3.3.2.2.10.3 recommends that a plant-specific program be credited to manage this aging effect for copper alloy HVAC piping, piping components and piping elements in the auxiliary Systems.

The staff confirmed that only heat exchanger components, piping, fittings and valve bodies that align to GALL AMRs VII.F1-16 for the reactor building spray system, fuel oil system and the control building ventilation system that are fabricated from copper alloy materials that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program or the External Surface Monitoring Program are applicable to TMI-1. The staff noted that the reactor building spray system in which the applicant referenced Item VII.F1-16, is not an auxiliary system, but was grouped together with this GALL AMR item because the material, environment, and aging effect combination corresponded.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are consistent with the recommendations in the GALL Report, and that it is adequate to manage loss of material due to pitting and crevice corrosion in copper alloy HVAC piping, piping components and elements exposed to wetted air/gas environment on the internal surface.

The staff noted that for those AMR line items in LRA Section 3.2, in which the applicant references Item 3.3.1-25, the applicant listed the environment as air with borated water leakage, which is a more aggressive environment than a condensation environment. The staff confirmed in LRA Section 3.2, that for the same system, material and environment combination, the applicant manages loss of material due to boric acid corrosion with the Boric Acid Corrosion Program, which is consistent with the GALL Report. The staff noted that the applicant is managing aging of these components for loss of material due to pitting and crevice corrosion with the External Surfaces Monitoring Program. The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.16. The staff determined that the External Surfaces Monitoring Program, which includes periodic visual inspections performed during system walkdowns, is adequate to manage loss of material due to pitting and crevice corrosion for copper alloy HVAC piping, piping components, and piping elements exposed to an external condensation environment addressed by this AMR. The staff finds that the External Surfaces Monitoring Program requires periodic visual inspections of external surfaces during periodic system maintenance to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are consistent with the recommendations in the GALL Report, and that it is adequate to manage loss of material due to pitting and crevice corrosion for copper alloy HVAC piping, piping components and piping elements exposed condensation on the external surface.

(4) LRA Section 3.3.2.2.10 states that the One-Time Inspection Program will be implemented to verify the effectiveness of the Lubricating Oil Analysis Program, to manage the loss of material due to pitting and crevice corrosion of the copper alloy heat exchanger components exposed to lubricating oil in the closed cycle cooling water system.

The staff reviewed LRA Section 3.3.2.2.10 against the criteria in SRP-LR Section 3.3.2.2.10 which states that loss of material due to pitting and crevice corrosion could occur for copper alloy piping, piping components, and piping elements exposed to lubricating oil. The effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lubricating oil program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and documented its findings in SER Sections 3.0.3.2.18 and 3.0.3.2.14 respectively and found that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting and crevice corrosion and 2) will require one-time inspection of select susceptible copper alloy piping, piping components, and piping elements exposed to lubricating oil for loss of material due to pitting and crevice corrosion to verify the effectiveness of the Lubricating Oil Analysis Program in the closed cycle cooling water system. Therefore, the staff finds that, based on a review of the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.10.

LRA Section 3.3.2.2.10 states that Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, will be implemented to manage the loss of material due to pitting and crevice corrosion of the copper alloy piping, piping components, and piping elements exposed to waste lubricating oil in the Radwaste System. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program consists of inspections of the copper alloy piping, piping components, and piping elements exposed to lubricating oil that are not covered by other aging management programs. These inspections are performed during the periodic system and component surveillances or during the performance of maintenance activities when the surfaces are made accessible for visual inspection. The program includes visual inspections to assure that existing environmental conditions are not causing material degradation that could result in a loss of component intended functions.

LRA Section 3.3.2.2.10 addresses loss of material due to pitting and crevice corrosion in copper alloy piping and components exposed to lubricating oil. The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will manage this aging effect in copper alloy piping and components exposed to lubricating oil. The staff reviewed LRA Section 3.3.2.2.10 against the criteria in SRP-LR Section 3.3.2.2.10, which states that loss of material due to pitting and crevice corrosion may occur in copper alloy piping and components exposed to lubricating oil.

The GALL Report, under Items VII.C1-8, VII.C2-5, VII.E1-12, VII.E4-6, VII.G-11 and VII.H2-10 and SRP-LR Section 3.3.2.2.10 recommends that Lubricating Oil Analysis Program be credited to manage this aging effect and that a plant-specific AMP be evaluated and credited to verify that the Lubricating Oil Analysis Program is achieving its mitigative function to manage this aging effect for copper alloy piping and piping components and elements. These GALL AMRs states that a one-time inspection program is an acceptable AMP to credit for the verification of the effectiveness of the Lubricating Oil Analysis Program.

The staff confirmed that only pump casings, sight glasses and valve bodies that align to GALL AMRs VII.E1-12 for the radwaste system that are fabricated from copper alloy materials that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program are applicable to TMI-1.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are adequate to manage loss of material due to pitting and crevice corrosion in copper alloy piping, piping components and elements exposed to lubricating oil.

(5) LRA Section 3.3.2.2.10 addresses loss of material due to pitting and crevice corrosion in HVAC aluminum piping, piping components, and piping elements and stainless steel ducting and components exposed to condensation. The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will manage this aging effect in stainless steel internal surfaces exposed to condensation

(wetted air/gas). The staff reviewed LRA Section 3.3.2.2.10 against the criteria in SRP-LR Section 3.3.2.2.10, which states that loss of material due to pitting and crevice corrosion may occur in HVAC aluminum piping, piping components and piping elements and stainless steel ducting components exposed to condensation. The staff noted that only stainless steel components is applicable to TMI-1 and therefore the portion relating to aluminum components will not be discussed in this section of the SER.

The GALL Report, under Item VII.F1-1, VII.F2-1, VII.F3-1, VII.F1-14, VII.F2-12, VII.F3-14 and VII.F4-10 and SRP-LR Section 3.3.2.2.10.5 recommends that a plant-specific program be credited to address this aging effect for stainless steel ducting and components and piping elements in the auxiliary systems.

The staff confirmed that only filter housing, piping, fittings, sight glasses, steam traps, tanks, thermowells and valve bodies that align to GALL AMRs VII.F1-1, VII.F2-1 and VII.F3-1 for the auxiliary and fuel handling ventilation system, extraction steam system, main steam system, primary containment heating and ventilation system and the steam turbine and auxiliary system that are fabricated from stainless steel materials are applicable to TMI-1 that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The staff noted that the steam turbine and auxiliary system, the extraction steam system, and the main steam system in which the applicant has referenced Item VII.F1-1, are not auxiliary systems, but were grouped together with this GALL AMR item because the material, environment, and aging effect combination corresponded.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are consistent with the recommendations in the GALL Report, and that it is adequate to manage loss of material due to pitting and crevice corrosion in stainless steel components exposed to condensation. (6) LRA Section 3.3.2.2.10 addresses loss of material due to pitting and crevice corrosion in copper alloy fire protection system piping, piping components and piping elements exposed to internal condensation. The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program performs visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are consistent with the recommendations in the GALL Report, and that it is adequate to manage loss of material due to pitting and crevice corrosion in copper alloy piping, piping components and piping elements exposed to internal condensation. LRA Section 3.3.2.2.10 states that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will be used to manage loss of material due to pitting and crevice corrosion of the cooper alloy piping, piping components and piping elements exposed to wetted air in the emergency diesel generators and auxiliary system, radwaste system, and reactor building spray system. The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are consistent with the recommendations in the GALL Report, and that it is adequate to manage loss of material due to pitting and crevice corrosion in copper alloy piping, piping components and piping elements exposed to internal condensation.

LRA Section 3.3.2.2.10 states that the Compressed Air Monitoring Program will be used to manage loss of material due to pitting and crevice corrosion of the copper alloy piping, piping components, piping elements, and heat exchanger components exposed to wetted air in the control building ventilation system, and instrument and control air system. The applicant stated that the Compressed Air Monitoring Program consists of inspections of the internal surfaces of copper alloy components.

SRP-LR Section 3.3.2.2.10 invokes AMR Item 28 in Table 3 of the GALL Report, Volume 1, and GALL AMR Item VII.G-9, applicable to copper alloy piping components exposed to condensation in the fire protection system, and recommends a plant-specific aging management program.

The staff reviewed the Compressed Air Monitoring Program, which includes periodic visual inspection of internal surfaces of piping and heat exchanger components for loss of material and fouling, monitoring of system air quality in accordance with industry standards and guidelines, and is consistent with the GALL AMP XI.M24, "Compressed Air Monitoring." The staff reviewed the Compressed Air Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.8. On the basis that periodic visual inspection will be performed, the staff finds that the Compressed Air Monitoring program will adequately manage loss of material due to pitting and crevice corrosion of copper alloy piping, piping components, piping elements, and heat exchanger components exposed to wetted air in the control building ventilation system, and instrument and control air system through the period of extended operation.

Based on a review of the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10 criteria. For those line items that apply to LRA Section 3.3.2.2.10, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Section 3.3.2.2.10 states that the Fire Protection Program will be used to manage loss of material due to pitting and crevice corrosion of the copper alloy spray nozzles exposed to wetted air in the fire protection System. The applicant further stated that the Fire Protection Program includes monitoring, testing, and inspection activities including low-pressure carbon dioxide fire suppression system flow testing to verify flow from each nozzle. The applicant also stated that any adverse conditions such as broken or missing parts, loose fasteners, excessive dirt or debris, or other degrading condition are required to be reported for corrective action evaluation.

SRP-LR Section 3.3.2.2.10 invokes AMR Item 28 in Table 3 of the GALL Report, Volume 1, and GALL AMR Item VII.G-9, applicable to copper alloy piping components exposed to condensation in the fire protection system, and recommends a plant-specific aging management program.

The staff reviewed the Fire Protection Program, which includes inspection and performance testing of low-pressure carbon dioxide system components at periodic intervals, and is consistent with GALL AMP XI.M26, "Fire Protection." The staff reviewed the Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.9. On the basis that inspection and testing will be performed, the staff finds that the Fire Protection Program will adequately manage loss of material due to pitting and crevice corrosion of copper alloy spray nozzles exposed to wetted air in the fire protection system through the period of extended operation.

LRA Section 3.3.2.2.10 states that the Fire Water System Program will be used to manage loss of material due to pitting and crevice corrosion of the copper alloy sprinkler heads exposed to wetted air in the fire protection system. The Fire Water System Program manages the aging effects of fire water system sprinkler heads through system monitoring, periodic tests and inspection activities.

The staff reviewed LRA Section 3.3.2.2.10 against the criteria in SRP-LR Section 3.3.2.2.10, which states that loss of material due to pitting and crevice corrosion could occur for copper alloy fire protection system components exposed to internal condensation. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure these aging effects are adequately managed.

SRP-LR Section 3.3.2.2.10 invokes AMR Item 28 in Table 3 of the GALL Report, Volume 1, and GALL AMR Item VII.G-9, applicable to copper alloy piping components exposed to condensation in the fire protection system, and recommends a plant-specific aging management program.

The staff reviewed the Fire Water System Program, which manages identified aging effects for the water-based fire protection system and associated components, through the use of periodic inspections, monitoring, and performance testing, and finds that it is consistent with the GALL AMP XI.M27, "Fire Water System." As recommended by the GALL AMP XI.M27, the applicant has committed to testing or replacement of sprinkler heads that have been in service for 50 years. The staff's review of the Fire Water System Program and its evaluation is documented in SER Section 3.0.3.2.10. On the basis that the sprinkler heads will be tested or replaced, the staff finds that the Fire Water System Program will adequately manage loss of material due to pitting and crevice corrosion of copper alloy sprinkler heads exposed to wetted air in the fire protection system through the period of extended operation.

(7) LRA Section 3.3.2.2.10 states that the Buried Piping and Tanks Inspection Program, will be implemented to manage loss of material due to pitting and crevice corrosion of the stainless steel piping, piping components, and piping elements exposed to soil in the fire protection system. The Buried Piping and Tanks Inspection Program consists of preventive measures to mitigate corrosion and periodic inspection to manage the effects of corrosion on the pressure-retaining capacity of buried stainless steel piping, piping components, and piping elements.

The staff reviewed LRA Section 3.3.2.2.10 against the criteria in SRP-LR Section 3.3.2.2.10 which states that loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

In LRA Table 3.3.2-10, the applicant stated that loss of material of stainless steel piping exposed to the buried (ext) environment is managed with the Buried Piping and Tank Inspection Program. During the audit, the staff noted that for the AMR results line that references LRA Table 3.3.2, the applicant included a reference to Generic Note E. The staff reviewed the AMR results line referenced to Generic Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends a plant specific program, the applicant has proposed using the Buried Piping and Tank Inspection Program.

The staff reviewed the Buried Piping and Tanks Inspection Program, and its evaluation is documented in SER Section 3.0.3.2.15. The staff finds that this program will provide planned inspections within ten years from entering the period of extended operation unless an opportunistic inspection has occurred within this ten-year period for stainless steel components exposed to soil for loss of material due to pitting and crevice corrosion in Fire Protection System. The LRA Appendix B, Buried Piping and Tanks Inspection Program is in accordance with the recommendations of GALL AMP XI.M34 "Buried Piping and Tanks Inspection." The staff noted that although GALL AMP XI.M34 cites applicability to only steel and gray cast iron components, stainless steel components that are subject to the provisions of GALL AMP XI.M34 will also be adequately managed for loss of material. The staff noted that the inspection methods used for buried cast iron, carbon steel and concrete-coated steel are applicable to buried stainless steel as well. The staff noted that buried stainless steel piping is more resistant to pitting and crevice corrosion than carbon steels and other materials addressed in GALL AMP XI.M34, "Buried Piping and Tanks Inspection," when exposed to soil and that visual inspection of stainless steel will detect unacceptable loss of material.

(8) LRA Section 3.3.2.2.10 addresses loss of material due to pitting and crevice corrosion, stating that this aging effect is not applicable to TMI-1, which is a PWR.

SRP-LR Section 3.3.2.2.10 states that loss of material due to pitting and crevice corrosion may occur in stainless steel piping, piping components, and piping elements of the BWR standby liquid control system exposed to sodium pentaborate solution.

TMI-1 is a PWR and does not have a standby liquid control system. The staff agrees that this item is not applicable to TMI-1.

Based on a review of the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10 criteria. For those line items that apply to LRA Section 3.3.2.2.10, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

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

The staff reviewed LRA Section 3.3.2.2.11 against the criteria in SRP-LR Section 3.3.2.2.11. LRA Section 3.3.2.2.11 addresses loss of material due to pitting ,crevice, and galvanic corrosion, stating that this aging effect is not applicable to TMI-1, which is a PWR.

SRP-LR Section 3.3.2.2.11 states that loss of material due to pitting, crevice, and galvanic corrosion may occur in copper alloy piping, piping components, and piping elements exposed to treated water.

This item pertains to loss of material in copper alloy auxiliary system components exposed to a BWR treated water environment. TMI-1 is a PWR. The staff agrees that this item is not applicable to TMI-1.

Based on the above, the staff concludes that SRP-LR Section 3.3.2.2.11 criteria do not apply.

3.3.2.2.12 Loss of Material due to Pitting, Crevice, and MIC

The staff reviewed LRA Section 3.3.2.2.12 against the criteria in SRP-LR Section 3.3.2.2.12.

(1) LRA Section 3.3.2.2.12 states that the One-Time Inspection Program, will be implemented to verify the effectiveness of the Fuel Oil Chemistry Program, to manage the loss of material due to pitting, crevice, and microbiologically-influenced corrosion of the stainless steel and copper alloy (Zn greater than 15%), piping components, and piping elements exposed to fuel oil in the auxiliary steam system, emergency diesel generators and auxiliary systems, fuel oil system, and station blackout and ups, diesels and auxiliary systems.

The staff reviewed LRA Section 3.3.2.2.12 against the criteria in SRP-LR Section 3.3.2.2.12 which states that loss of material due to pitting, crevice, and MIC could occur in stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to fuel oil. Corrosion may occur at locations where contaminants accumulate and the effectiveness of fuel oil chemistry control should be verified to ensure that corrosion is not occurring. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff reviewed the Fuel Oil Chemistry Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.12 and 3.0.3.2.14 respectively. The staff finds that that these programs 1) provide for periodic sampling of fuel oil and periodic, draining, cleaning and visual inspection of fuel tanks to maintain contaminants at acceptable limits to preclude loss of material due to pitting and corrosion and 2) will require one-time inspection of select susceptible stainless steel and copper alloy piping, piping components, piping elements to fuel oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion to verify the effectiveness of the Fuel Oil Chemistry Program in applicable auxiliary systems.

The applicant stated that pitting and crevice corrosion is not predicted for copper alloys with zinc content less than 15% in a fuel oil environment. The staff determined that additional information was required to complete its review. In RAI 3.3.2.2-1, dated October 16, 2008, the staff requested that the applicant provide additional information that demonstrates copper alloys with zinc content less than 15% are not subject to pitting and crevice corrosion when exposed to fuel oil.

In its response to the RAI dated November 12, 2008, the applicant stated that the EPRI Report 1010639, "Non-Class 1 Mechanical Tools," Revision 4, Appendix C, does not predict pitting and crevice corrosion of copper alloys with zinc content less than 15% when exposed to fuel oil. The staff noted that just citing EPRI Report 1010639 alone does not provide the staff with sufficient information to complete its evaluation.

In RAI AMR-Generic-3, dated January 05, 2009, the staff requested that the applicant provide additional information stating the reason why pitting and crevice corrosion are not active in copper alloys with zinc content less than 15% when exposed to fuel oil.

In its response to the RAI dated January 12, 2009, the applicant stated that in order to be consistent with corrosion of copper alloys with zinc content less than 15% exposed to lubricating oil, where pitting and crevice corrosion is predicted, pitting and crevice corrosion will be included as aging mechanisms for copper alloy with zinc content less than 15% in a fuel oil environment.

Based on its review, the staff finds that applicant's response to RAI 3.3.2.2-1 acceptable because the changes made by the applicant to manage pitting and crevice corrosion of copper alloy with zinc content less than 15% in a fuel oil environment, result in no exception to the SRP-LR. The staff's concern described in RAI 3.3.2.2-1 is resolved.

(2) LRA Section 3.3.2.2.12 states that the One-Time Inspection Program, will be implemented to verify the effectiveness of the Lubricating Oil Analysis Program, to manage the loss of material due to pitting, crevice, and microbiologically-influenced corrosion of the stainless steel piping, piping components, piping elements, heat exchanger components, and tanks exposed to lubricating oil in the decay heat removal system, emergency diesel generators and auxiliaries system, makeup and purification system, reactor coolant system, and station blackout and UPS diesel generator system.

The staff reviewed LRA Section 3.3.2.2.12 against the criteria in SRP-LR Section 3.3.2.2.12 which states that loss of material due to pitting, crevice, and MIC could occur in stainless steel piping, piping components, and piping elements exposed to lubricating oil. The existing program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. The effectiveness of the lubricating oil program is verified through one-time inspection of selected components at susceptible locations to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14 respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting, crevice, and microbiologically-influenced corrosion and 2) will require one-time inspection of select susceptible stainless steel piping, piping components, and piping elements exposed to lubricating oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion to verify the effectiveness of the Lubricating Oil Analysis Program in applicable auxiliary systems. Therefore, the staff finds that, based on a review of the programs identified above, the applicant has met the criteria of SRP-LR Section 3.3.2.2.12.

(3) LRA Section 3.3.2.2.12 states that the External Surfaces Monitoring Program will be implemented to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion of the stainless steel drip pans exposed to waste lubricating oil in the fire protection system. The External Surfaces Monitoring Program consists of system inspections and walkdowns. This program includes periodic visual inspections of components within the scope of license renewal and subject to AMR in order to manage aging effects. The program manages aging effects through visual inspection of external surfaces for evidence of aging effects. The External Surfaces Monitoring program is described in Appendix B.

The staff noted that in Auxiliary System Tables 3.3.2.-2, 3.3.2-9, 3.3.2-12, and 3.3.2-24 that for copper alloy (Zn content less 15%) piping, fittings, and valves exposed to a fuel oil environment, loss of material due to microbiologically influence corrosion is managed with the Fuel Oil Chemistry Program and the One-Time Inspection Program. The applicant assigned a note "I" for these cases although the assignment of the Fuel Oil Chemistry Program and the One-Time Inspection Program to manage loss of material due to MIC is in accordance with GALL Report. In addition, the staff noted that loss of material due to MIC for copper alloys with zinc content less than 15% is addressed in Section 3.3.2.2.12 of the LRA. The staff determined that additional information was needed to complete its review. In RAI 3.3.2.2-1, dated October 16, 2008, the staff requested that the applicant provide additional information justifying the use of Note "I" (Aging effect in NUREG-1801 for this component, material and environment combination is not applicable) for copper alloy (Zn content less 15%) piping, fittings, and valves exposed to a fuel oil environment, when loss of material due to MIC is managed with the Fuel Oil Chemistry Program and the One-Time Inspection Program as addressed in the GALL Report.

In its response to the RAI dated November 12, 2008, the applicant stated that Generic Note "I" is used for this material, component, and environment because pitting and crevice corrosion does not apply for this material, component, and environment combination.

Based on its review, the staff finds the applicant's response to RAI 3.3.2.2-1 unacceptable because the applicant did not provide the reason why Generic Note "I" was used for this material, component, and environment. The applicant also did not explain why pitting and crevice corrosion does not apply for this material, component, and environment combination.

In RAI ARM-Generic-3, dated January 5, 2009, the staff requested in part, that the applicant state the reasons why pitting and crevice corrosion is not predicted for copper alloys with less than 15% zinc in a fuel oil environment.

In its response to the RAI dated January 12, 2009, the applicant committed to manage pitting and crevice corrosion of copper alloy (Zn content less 15%) components exposed to fuel oil using the Fuel Oil Chemistry Program and the One-Time Inspection Program.

Based in its review, the staff finds the applicant's response to the applicable part of RAI-AMR-Generic-3 acceptable because the changes made by the applicant to manage pitting and crevice corrosion of copper alloy with zinc content less than 15% in a fuel oil environment, result in no exception to the GALL report. The staff concern in RAI 3.3.2.2-1 and the applicable part of RAI-AMR-Generic-3 is resolved.

LRA Section 3.3.2.2.12 addresses the loss of material due to pitting, crevice and microbiologically-influenced corrosion for stainless steel piping, piping components and piping elements exposed to lubricating oil internally or externally. The staff reviewed LRA Section 3.3.2.2.12 against the criteria in SRP-LR Section 3.3.2.2.12, which states that loss of material due to pitting, crevice and microbiologically-influenced corrosion may occur in stainless steel piping, piping components and piping elements exposed to lubricating oil internally or externally.

The GALL Report, under Items VII.C1-14, VII.C2-12, VII.E1-15, VII.E4-12, VII.G-18 and VII.H2-17 and SRP-LR Section 3.3.2.2.12 recommends that Lubricating Oil Analysis Program be credited to manage this aging effect and that a plant-specific AMP be evaluated and credited to verify that the Lubricating Oil Analysis Program is achieving its mitigative function to manage loss of material due to pitting, crevice and microbiologically-influenced corrosion for stainless steel piping, piping components. These GALL AMRs state that a one-time inspection program is an acceptable AMP to credit for the verification of the effectiveness of the Lubricating Oil Analysis Program. The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program or the External Surfaces Monitoring Program will manage this aging effect in stainless steel internal surfaces or external surfaces, respectively, exposed to lubricating oil.

The staff confirmed that only piping, fittings, drip pan, tanks and valve bodies that align to GALL AMR VII.G-18 for the fire protection system that are fabricated from stainless steel materials that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program or the External Surfaces Monitoring Program are applicable to TMI-1.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are adequate to manage loss of material due to pitting, crevice and microbiologically-influenced corrosion stainless steel piping, piping components and piping elements exposed to lubricating oil on the internal surface.

The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.16. The staff finds that the External Surfaces Monitoring Program which includes periodic visual inspections performed during system walkdowns, is adequate to manage loss of material due to pitting, crevice and microbiologically-influenced corrosion and detect aging effects that could result in a loss of the component's intended function for stainless steel components exposed to external lubricating oil environment addressed by this AMR. The staff finds that this program includes activities that are adequate to manage loss of material due to pitting, crevice and MIC in stainless steel piping, piping components and piping elements exposed to lubricating oil on the external surface.

Based on a review of the programs identified above, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.12 criteria. For those line items that apply to LRA Section 3.3.2.2.12, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.13 Loss of Material due to Wear

The staff reviewed LRA Section 3.3.2.2.13 against the criteria in SRP-LR Section 3.3.2.2.13. LRA Section 3.3.2.2.13 refers to LRA Table 3.3.1, line item 34, and addresses loss of material due to wear for elastomer seals and components exposed to air – indoor uncontrolled (internal or external). The applicant stated that the component, material, environment, and aging effect/mechanism does not apply to auxiliary systems.

SRP-LR Section 3.3.2.2.13 states that loss of material due to wear may occur in the elastomer seals and components exposed to air - indoor uncontrolled (internal or external). The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed. In RAI AMR-Generic-2, dated January 5, 2009, the staff requested that the applicant provide additional information to justify why LRA Table 3.3.1, Item 3.3.1-34 is not applicable. In its response to the RAI dated January 12, 2009, the applicant stated the item is not applicable because this component, material, environment, and aging effect/mechanism combination does not exist in auxiliary systems. The applicant also stated that the ventilation system elastomer components are not subject to relative motion between surfaces and therefore do not include the loss of material due to wear.

Based on its review of the LRA, the staff confirmed that this component, material, environment, and aging effect/mechanism combination does not exist in auxiliary systems and that the ventilation system elastomer components are not subject to relative motion between surfaces, and, therefore, the staff finds the applicant's determination acceptable.

Based on the above, the staff concludes that SRP-LR Section 3.3.2.2.13 criteria do not apply.

3.3.2.2.14 Loss of Material due to Cladding Breach

The staff reviewed LRA Section 3.3.2.2.14 against the criteria in SRP-LR Section 3.3.2.2.14.

LRA Section 3.3.2.2.14 refers to LRA Table 3.3.1, line item 35, and addresses loss of material due to cladding breach for steel with stainless steel cladding pump casing exposed to treated borated water. The applicant stated that the component, material, environment, and aging effect/mechanism does not apply to auxiliary systems.

SRP-LR Section 3.3.2.2.14 states that loss of material due to cladding breach (also referred to as underclad cracking may occur in PWR steel charging pump casings with stainless steel cladding exposed to treated borated water. The GALL Report references IN 94-63, "Boric Acid Corrosion Of Charging Pump Casing Caused By Cladding Cracks," and recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed.

In RAI AMR-Generic-2, dated January 5, 2009, the staff requested that the applicant provide additional information to justify why LRA Table 3.3.1, Item 3.3.1-35 is not applicable.

In its response to the RAI dated January 12, 2009, the applicant stated the item is not applicable *because there are no steel with stainless steel cladding pump casings exposed to treated borated* water in auxiliary systems.

Based on its review of the LRA, the staff confirmed that there are no steel with stainless steel cladding pump casings exposed to treated borated water in auxiliary systems and, therefore, the staff finds the applicant's determination acceptable.

Based *on the above, the staff concludes that* SRP-LR *Section* 3.3.2.2.14 *criteria do not apply.*

3.3.2.2.15 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA program.

3.3.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.3.2-1 through 3.3.2-25, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.3.2-1 through 3.3.2-25, the applicant indicated, via Notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. Specifically, Note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant had demonstrated that the aging effects will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.3.2.3.1 Auxiliary Systems – Auxiliary and Fuel Handling Building Ventilations Systems – Summary of Aging Management Evaluation – LRA Table 3.3.2-1

The staff reviewed LRA Table 3.3.2-1, which summarizes the results of AMR evaluations for the auxiliary and fuel handling building ventilations systems component groups.

In LRA Table 3.3.2-1, the applicant proposed to manage loss of preload/thermal effects, gasket creep, and self loosening for carbon and low alloy steel mechanical closure bolting in an outdoor air (external) environment using the Bolting Integrity Program. The AMR line items cite Generic Note H, *which indicates that the aging effect is not addressed in the GALL Report for this* component, material and environment combination.

The staff reviewed the applicant's Bolting Integrity Program and its evaluation is documented in SER Section 3.0.3.1.3. The LRA states that this program manages the loss of material due to general, pitting and crevice corrosion, microbiologically-influenced corrosion (MIC) and loss of preload due to thermal effects, gasket creep, and self-loosening. The staff found that the aging effects are managed through the implementation of procedures which follow NRC approved guidance. Additionally, the LRA line item is similar to GALL item VII.I-5, which accounts for an air-indoor uncontrolled (external) environment, but not an air-outdoor (external) environment. This environment consists of moist air, exposure to weather, precipitation, and wind. TMI-1 inspects for loss of preload using methods including inspecting for leakage indicating loss of preload, and for loose bolts. Therefore, the staff concludes that the management of loss of preload/thermal effects, gasket creep, and self loosening for carbon and low alloy steel mechanical closure bolting in an outdoor air (external) environment is acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.2 Auxiliary Systems – Auxiliary Steam System – Summary of Aging Management Evaluation – LRA Table 3.3.2-2

The staff reviewed LRA Table 3.3.2-2, which summarizes the results of AMR evaluations for the auxiliary steam system component groups.

In LRA Table 3.3.2-2, the applicant proposed to manage loss of material due to pitting and crevice corrosion for steel material for valve bodies exposed to an air/gas wetted internal environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material combination.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities, or during maintenance activities when the internal surface is accessible for visual inspections, to detect aging effects that could result in a loss of the component's intended function. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.3 Auxiliary Systems – Circulating Water System – Summary of Aging Management Evaluation – LRA Table 3.3.2-3

The staff reviewed LRA Table 3.3.2-3, which summarizes the results of AMR evaluations for the circulating water system component groups.

In LRA Table 3.3.2-3, the applicant designated Note H for copper alloy heat exchanger components exposed to a lubricating oil environment in the circulating water system (Table 3.3.2-3) because the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report for heat exchanger components and the staff reviewed the GALL Report and concluded that the AMR line item, copper alloy heat exchanger components is not evaluated for a lubricating oil for loss of material due to pitting, crevice, microbiologically influence corrosion. The applicant credits the Lubricating Oil Analysis Program and the One-time Inspection Program for managing loss of material due to pitting, crevice, microbiologically influence corrosion. The staff evaluated the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively.

The staff noted that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting, crevice and microbiologically-influenced corrosion and 2) will perform one-time inspection of select susceptible components exposed to lubricating oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion to verify the effectiveness of the Lubricating Oil Analysis Program. The staff noted that the one-time inspection is an acceptable method to determine whether or not loss of material is occurring slowly such that the intended function will be maintained during the period of extended operation. On this basis, the staff finds that the Lubricating Oil Analysis and the One-Time Inspection programs are adequate to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion for these copper alloy components through the period of extended operation.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.4 Auxiliary Systems – Closed Cycle Cooling Water System – Summary of Aging Management Evaluation – LRA Table 3.3.2-4

The staff reviewed LRA Table 3.3.2-4, which summarizes the results of AMR evaluations for the closed cycle cooling water system component groups.

In LRA Table 3.3.2-4, the applicant proposed to manage reduction of heat transfer due to fouling for copper alloy with 15% zinc or more material for heat exchanger components exposed to an external air environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material combination. The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program performs periodic visual inspections of internal surfaces during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff further noted that these periodic visual inspections are adequate to manage reduction of heat transfer due to fouling for these components, because a visual inspection will be capable of detecting any fouling (build up from whatever source) on the internal surface of these components. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections when exposed to an internal environment of external indoor air they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

In LRA Table 3.3.2-4, the applicant proposed to manage reduction of heat transfer due to fouling for copper alloy with 15% zinc or more material for heat exchanger components exposed to an external air with borated water leakage environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material combination. The staff confirmed in LRA Section 3.3, that for the same system, component, material and environment combination, the applicant manages loss of material due to boric acid corrosion with the AMP B.2.1.4, "Boric Acid Corrosion Program," as recommend by GALL.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities and during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff further noted that these periodic visual inspections are adequate to manage reduction of heat transfer due to fouling for these components exposed to external air with borated water leakage addressed by this AMR because a visual inspection will be capable of detecting any fouling (build up from whatever source) on the surface of these components. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections, they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.5 Auxiliary Systems – Containment Isolation System – Summary of Aging Management Evaluation – LRA Table 3.3.2-5

The staff reviewed LRA Table 3.3.2-5, which summarizes the results of AMR evaluations for the containment isolation system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.6 Auxiliary Systems – Control Building Ventilation System – Summary of Aging Management Evaluation – LRA Table 3.3.2-6

The staff reviewed LRA Table 3.3.2-6, which summarizes the results of AMR evaluations for the control building ventilation system component groups.

In LRA Table 3.3.2-6, the applicant stated that for glass sight glasses in closed cycle cooling water environment there are no aging effects requiring management. The applicant referenced Generic Note G for this line item, indicating that environment is not listed in the GALL Report for this component and environment combination.

As indicated in the "Corrosion Handbook" by H.H.Uhlig, the staff noted that glass, as a material, is impervious to normal plant environments. This conclusion is based on industry experience where the staff noted that no failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at temperatures or during time periods of concern for extended operation. The staff acknowledges that the use of glass in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation, since the closed-cycle cooling water environment does not contain hydroflouric acid or caustics. The staff reviewed the GALL Report and noted that item VII.J-13 indicates that glass in a treated water environment has no aging effects that require aging management. On the basis that the closed cycle cooling water environment is similar to a treated water environment, the staff finds that glass in a closed cycle cooling water environment will not have any aging effects requiring aging management.

In LRA Table 3.3.2-6, the applicant proposed to manage reduction of heat transfer due to fouling for copper alloy with less than 15% zinc material for heat exchanger components exposed to an external indoor air environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff further noted that these periodic visual inspections are adequate to manage reduction of heat transfer due to fouling for these components exposed to indoor air environment addressed by this AMR because a visual inspection will be capable of detecting any fouling (build up from whatever source) on the surface of these components. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections, they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be

adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.7 Auxiliary Systems – Cranes and Hoists – Summary of Aging Management Evaluation – LRA Table 3.3.2-7

The staff reviewed LRA Table 3.3.2-7, which summarizes the results of AMR evaluations for the cranes and hoists component groups.

In LRA Table 3.3.2-7, the applicant proposed to manage loss of material/wear for carbon steel crane/hoist (rail system) externally exposed to outdoor air using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program. The AMR line item cites Generic Note E, which indicates that the material, aging effect, and environment are consistent with the NUREG-1801 however a different aging management program is credited.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is document in SER Section 3.0.3.2.7. The LRA states that this program manages the effects of general corrosion on the crane and trolley structural components and the effects of wear on the rails in the rail system. Inspection frequency is annually for cranes and hoists that are accessibly during plant operation and every 2 years for cranes and hoists that are only accessible during refueling outages. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance, and inspected using visual techniques. Therefore, the staff concludes that the management of loss of material/wear for carbon steel crane/hoist (rail system) externally exposed to outdoor air is acceptable.

In LRA Table 3.3.2-7, the applicant proposed to manage loss of material/general, pitting and crevice corrosion for carbon steel crane/hoist (bridge/trolley/girders), crane/hoist (jib crane columns/beams/plates/anchorage), crane/hoist (monorail beams/lifting devices/plates), and crane/hoist (rail system) externally exposed to an outdoor air environment using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program for 4 AMR line items. The AMR line items cite Generic Note E, which indicates that the material, aging effect, and environment are consistent with the NUREG-1801 however a different aging management program is credited.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is documented in SER Section 3.0.3.2.7. The LRA states that this program manages the effects of general corrosion on the crane and trolley structural components and the effects of wear on the rails in the rail system. Inspection frequency is annually for cranes and hoists that are accessibly during plant operation and every 2 years for cranes and hoists that are only accessible during refueling outages. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance, and inspected using visual techniques. Additionally, these particular line items reference GALL item VII.H1-8, which accounts for the same material, environment, and aging effect. The aging management program identified to manage this line item is not the "External Surfaces Monitoring Program" as specified by GALL. However, the applicant has identified this discrepancy with a plant specific note, and the staff has evaluated the proposed Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program for aging management adequacy as stated above. Therefore, the staff concludes that the management of loss of material/wear for carbon steel crane/hoist (rail system) externally exposed to outdoor air is acceptable.

In LRA Table 3.3.2-7, the applicant proposed to manage loss of material/general, pitting and crevice corrosion for carbon and low alloy steel bolting externally exposed to an outdoor air environment using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program. The AMR line item cites Generic Note E, which indicates that the material, aging effect, and environment are consistent with the GALL Report, however a different aging management program is credited.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is documented in SER Section 3.0.3.2.7. The LRA states that this program manages the effects of general corrosion on the crane and trolley structural components and the effects of wear on the rails in the rail system. Inspection frequency is annually for cranes and hoists that are accessibly during plant operation and every 2 years for cranes and hoists that are only accessible during refueling outages. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance, and inspected using visual techniques. Therefore, the staff concludes that the management of loss of material/general, pitting and crevice corrosion for carbon and low alloy steel bolting externally exposed to an outdoor air environment is acceptable.

In LRA Table 3.3.2-7, the applicant proposed to manage loss of material/general, pitting and crevice corrosion for carbon and low alloy steel bolting externally exposed to indoor air and air with borated water leakage environments using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program for 2 AMR line items. The AMR line items cite Generic Note E, which indicates that the material, aging effect, and environment are consistent with the GALL Report, however, a different aging management program is credited.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is document in SER Section 3.0.3.2.7. The LRA states that this program manages the effects of general corrosion on the crane and trolley structural components and the effects of wear on the rails in the rail system. Inspection frequency is annually for cranes and hoists that are accessibly during plant operation and every 2 years for cranes and hoists that are only accessible during refueling outages. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance, and inspected using visual techniques. Therefore, the staff concludes that the management of loss of material/general, pitting and crevice corrosion for carbon and low alloy steel bolting externally exposed to indoor air and air with borated water leakage environments is acceptable.

In LRA Table 3.3.2-7, the applicant proposed to manage loss of material/general, pitting and crevice corrosion for carbon steel crane/hoist (bridge/trolley/girders), crane/hoist (jib crane columns/beams/plates/anchorage), crane/hoist (monorail beams/lifting devices/plates), and crane/hoist (rail system) externally exposed to an air with borated water leakage environment using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program for 4 AMR line items. The AMR line items cite Generic Note E, which indicates that the material, aging effect, and environment are consistent with the GALL Report, however, a different aging management program is credited.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is documented in SER Section 3.0.3.2.7. The LRA states that that this program manages the effects of general corrosion on the crane and trolley structural components and the effects of wear on the rails in the rail system. Inspection frequency is annually for cranes and hoists that are accessibly during plant operation and every 2 years for cranes and hoists that are only accessible during refueling outages. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance, and inspected using visual techniques. Additionally, these particular line items reference GALL item VII.I-4, which accounts for the same material, environment, and aging effect. The aging management program identified to manage this line item is not the External Surfaces Monitoring Program as specified by GALL. However, the applicant has identified this discrepancy with a plant specific note, and the staff has evaluated the proposed Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program for aging management adequacy as stated above. Therefore, the staff concludes that the management of loss of material/wear for carbon steel crane/hoist (rail system) externally exposed to outdoor air is acceptable.

In LRA Table 3.3.2-7, the applicant proposed to manage loss of material/pitting, crevice and microbiologically-influenced corrosion on stainless steel crane and hoist bolting externally exposed to lubricating oil using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is documented in SER Section 3.0.3.2.7. The LRA states that this program manages the effects of general corrosion on the crane and trolley structural components and the effects of wear on the rails in the rail system. Inspection frequency is annually for cranes and hoists that are accessibly during plant operation and every 2 years for cranes and hoists that are only accessible during refueling outages. The staff found that the aging effects are managed through the implementation of procedures which follow NRC approved guidance, and inspected using visual techniques. Therefore, the staff concludes that the management of loss of material/pitting, crevice and microbiologically-influenced corrosion on stainless steel crane and hoist bolting externally exposed to lubricating oil is acceptable.

In LRA Table 3.3.2-7, the applicant proposed to manage loss of preload/thermal effects, gasket creep, and self-loosening of stainless steel crane and hoist bolting externally exposed to lubricating oil using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is documented in SER Section 3.0.3.2.7. The staff verified that the Inspection of Overhead Heavy Load And Light Load (Related To Refueling) Handling Systems Program states the following: Structural bolting is monitored for loss of preload by inspecting for loose or missing bolts, or nuts. The staff determined that the method for inspecting for loss of preload specified by the Inspection Of Overhead Heavy Load And Light Load (Related To Refueling) Handling Systems Program is not affected by a lubricating oil environment. Therefore, the staff concludes that the management of loss of preload/thermal effects, gasket creep, and self-loosening of stainless steel crane and hoist bolting externally exposed to lubricating oil is acceptable.

In LRA Table 3.3.2-7, the applicant proposed to manage loss of preload/self-loosening for carbon and low alloy steel crane and hoist bolting externally exposed to outdoor air using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program. The

AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program as documented in SER Section 3.0.3.2.7. The staff verified that AMP B.2.1.11 specifically states that: "Structural bolting is monitored for loss of preload by inspecting for loose or missing bolts, or nuts." The staff determined that the method for inspecting for loss of preload specified by AMP B.2.1.11 is adequate for this component, material and environment combination. Therefore, the staff concludes that the management of loss of preload/self-loosening for carbon and low alloy steel crane and hoist bolting externally exposed to outdoor air is acceptable.

In LRA Table 3.3.2-7, the applicant proposed to manage loss of preload/self loosening for carbon and low alloy steel crane and hoist bolting externally exposed to indoor air using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program. The AMR line items cite Generic Note I, which indicates that the aging effect identified in the GALL Report for this component, material and environment combination is not applicable.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is documented in SER Section 3.0.3.2.7. The staff verified that the Inspection Of Overhead Heavy Load And Light Load (Related To Refueling) Handling Systems Program states the following: Structural bolting is monitored for loss of preload by inspecting for loose or missing bolts, or nuts. The staff determined that the method for inspecting for loss of preload specified by the Inspection Of Overhead Heavy Load And Light Load (Related To Refueling) Handling Systems Program is adequate for this component, material and environment combination. Therefore, the staff concludes that the management of loss of preload/self loosening for carbon and low alloy steel crane and hoist bolting externally exposed to indoor air is acceptable.

In LRA Table 3.3.2-7, the applicant proposed to manage loss of preload/self loosening for carbon and low alloy steel crane and hoist bolting externally exposed to air with borated water leakage using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program. The AMR line items cite Generic Note I, which indicates that the aging effect identified in the GALL Report for this component, material and environment combination is not applicable.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is documented in SER Section 3.0.3.2.7. The staff verified that the Inspection Of Overhead Heavy Load And Light Load (Related To Refueling) Handling Systems Program specifically states the following: Structural bolting is monitored for loss of preload by inspecting for loose or missing bolts, or nuts. The staff determined that the method for inspecting for loss of preload specified by the Inspection Of Overhead Heavy Load And Light Load (Related To Refueling) Handling Systems Program is adequate for this component, material and environment combination. Therefore, the staff concludes that the management of loss of preload/self loosening for carbon and low alloy steel crane and hoist bolting externally exposed to air with borated water leakage is acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be

adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.8 Auxiliary Systems – Diesel Generator Building Ventilation System – Summary of Aging Management Evaluation – LRA Table 3.3.2-8

The staff reviewed LRA Table 3.3.2-8, which summarizes the results of AMR evaluations for the diesel generator building ventilation system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.9 Auxiliary Systems – Emergency Diesel Generators and Auxiliary Systems – Summary of Aging Management Evaluation – LRA Table 3.3.2-9

The staff reviewed LRA Table 3.3.2-9, which summarizes the results of AMR evaluations for the emergency diesel generators and auxiliary systems component groups.

In LRA Table 3.3.2-9, the applicant proposed to manage reduction of heat transfer due to fouling for copper alloy with 15% zinc or more material for heat exchanger components exposed to an external indoor air environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities and during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff further noted that these periodic visual inspections are adequate to manage reduction of heat transfer due to fouling for these components exposed to external indoor air environment addressed by this AMR because a visual inspection will be capable of detecting any fouling (build up from whatever source) on the surface of these components. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections, they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

The staff reviewed LRA Table 3.3.2-9, which summarizes the results of AMRs for the emergency diesel generator and auxiliary system component groups. In LRA Table 3.3.2-9, the applicant stated that for glass sight glasses in a closed cycle cooling water environment there are no aging effects requiring management. The applicant referenced footnote "G" for this line item indicating that environment is not listed in the GALL Report for this component and environment combination.

As indicated in "Corrosion Handbook" by H.H.Uhlig, the staff noted that glass as a material is impervious to normal plant environments. This conclusion is based on industry experience where the staff noted that no failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at temperatures or during time periods of concern for extended operation. The staff acknowledges that the use of glass in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation, since closed-cycle cooling water environment does not contain hydroflouric acid or caustics. The staff reviewed the GALL Report and noted that item VII.J-13 indicates that glass in a treated water environment has no aging effects that requires aging management. On the basis that a closed cycle cooling water environment is similar to a treated water environment, the staff finds that glass in closed cycle cooling water environment will not have any aging effects requiring aging management.

In LRA Table 3.3.2-9, the applicant proposed to manage loss of preload/thermal effects, gasket creep, and self loosening for carbon and low alloy steel mechanical closure bolting in an outdoor air (external) environment using the Bolting Integrity Program. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff reviewed the applicant's Bolting Integrity Program and its evaluation is documented in SER Section 3.0.3.1.3. The LRA states that this program manages the loss of material due to general, pitting and crevice corrosion, MIC and loss of preload due to thermal effects, gasket creep, and self-loosening. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance. Additionally, the LRA line item is similar to GALL item VII.I-5, which accounts for an air-indoor uncontrolled (external) environment, but not an air- outdoor (external) environment. This environment consists of moist air, exposure to weather, precipitation, and wind. TMI-1 inspects for loss of preload using methods including inspecting for leakage indicating loss of preload, and for loose bolts. The staff concludes that the management of loss of preload/thermal effects, gasket creep, and self loosening for carbon and low alloy steel mechanical closure bolting in an outdoor air (external) environment is acceptable.

In LRA Table 3.3.2-9 the applicant designated Generic Note H for copper alloy heat exchanger components exposed to a lubricating oil environment in the emergency diesel generators and auxiliary systems because the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report for heat exchanger components. The staff reviewed the GALL Report and finds that the AMR line item for copper alloy heat exchanger components that are exposed to a lubricating oil environment are not evaluated for loss of material due to pitting, crevice, microbiologically influence corrosion and that Generic Note H is appropriate. The applicant credits the Lubricating Oil Analysis Program and the One-time Inspection Program for managing loss of material due to pitting, crevice, and MIC.

The staff reviewed the Lubricating Oil Analysis Program and the One-time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff noted that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting, crevice and microbiologically-influenced corrosion and 2) will require one-time inspection of select susceptible components exposed to lubricating oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion to verify the effectiveness of the Lubricating Oil Analysis Program. The staff noted that the one-time inspection is an acceptable method to determine whether or not loss of material is occurring slowly such that the intended function will be maintained during the period of extended operation. On this basis, the staff finds that the Lubricating Oil Analysis and the One-Time Inspection programs are adequate to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion for these copper alloy components through the period of extended operation.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.10 Auxiliary Systems – Fire Protection System – Summary of Aging Management Evaluation – LRA Table 3.3.2-10

The staff reviewed LRA Table 3.3.2-10, which summarizes the results of AMRs for the fire protection system component groups.

In LRA Table 3.3.2-10, the applicant proposed to manage loss of material due to microbiologically-influenced corrosion and fouling of aluminum alloy water motor alarm in an environment of raw water by using the Fire Water System Program. The applicant referenced footnote "H" for this line item indicating that aging effect is not in the GALL Report for this component, material and environment combination.

The staff reviewed the Fire Water System Program, which manages identified aging effects for the water-based fire protection system and associated components, through the use of periodic inspections, monitoring, and performance testing, and finds that it is consistent with the GALL AMP XI.M27, "Fire Water System." The staff reviewed the Fire Water System Program and its evaluation is documented in SER Section 3.0.3.2.10. On the basis that periodic inspection and monitoring and testing will be performed, the staff finds that the Fire Water System program will adequately manage loss of material due to microbiologically-influenced corrosion and fouling of aluminum piping components exposed to raw water in the fire protection system through the period of extended operation.

In LRA Table 3.3.2-10, the applicant proposed to manage change in material properties, loss of material and cracking of mecatiss and thermo-lag material fire barriers in air-indoor and air with borated water leakage external environments by using the Fire Protection program. The applicant referenced footnote "F" indicating the material is not in the GALL Report.

The staff reviewed the Fire Protection Program, which provides for periodic visual inspection of fire barrier penetration seals, fire barrier walls, ceilings and floors, and manages the aging effects of change in material properties, cracking, hardening and loss of material. The staff noted that the Fire Protection Program is consistent with the GALL AMP XI.M26, "Fire Protection," which recommends visual inspection of fire barriers at least once every refueling outage by qualified inspectors. The staff reviewed the Fire Protection Program and its evaluation is documented in SER Section 3.0.3.2.9. Based on this review, the staff finds that the Fire Protection program will adequately manage change in material properties, loss of material and cracking in fire barriers in the fire protection system through the period of extended operation because periodic inspection is performed to detect any signs of degradation before loss of intended function.

In LRA Table 3.3.2-10, the applicant proposed to manage concrete cracking and spalling and loss of material of concrete fire walls and slabs in an air with borated water leakage environment by using the Fire Protection Program. The applicant referenced footnote "G" and plant-specific footnote 18, indicating that this environment is not listed in the GALL Report for this material and component. The applicant also stated that concrete fire barriers (walls and slabs) with environment of air with borated water leakage have the same aging effects and mechanisms, and are managed with the same programs as air-indoor.

The staff reviewed the Fire Protection Program, which provides for periodic visual inspection of fire barrier penetration seals; fire barrier walls, ceilings and floors. The staff noted that the Fire Protection Program is consistent with the GALL AMP XI.M26, "Fire Protection," which recommends visual inspection of fire barriers at least once every refueling outage by qualified inspectors for any sign of degradation such as concrete cracking, spalling, and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates. The staff reviewed the Fire Protection program and its evaluation is documented in SER Section 3.0.3.2.9. Based on this review, the staff finds that the Fire Protection program will adequately manage change in material properties, loss of material and cracking in fire barriers in the fire protection system through the period of extended operation because periodic inspection is performed to detect any signs of degradation before loss of intended function.

In LRA Table 3.3.2-10, the applicant stated that for polymer piping and fittings in air-indoor external and air/gas – wetted internal environments, there are no aging effects requiring management. The applicant referenced footnote "F" stating that this material is not listed in the GALL Report.

In RAI 3.3.2.3-1, dated October 16, 2008, the staff requested that the applicant provide additional information identifying what polymer material is used and to justify why there are no aging effects requiring management for this material.

In its response to the RAI dated November 12, 2008, the applicant stated the following:

> The polymer piping and fitting component used in the fire protection system is Nylon 11 tubing and it is located inside the Control Building. Nylon 11 is a polyamide material with excellent resistance to acids, including boric acid. It is heat and light stabilized with a maximum operating temperature of 70 °C (158 °F). Nylon 11 is resistant to moisture, corrosion and stress cracking, and has good flexibility. The design temperature in the Control Building is 80 °F and the radiation level is negligible. Therefore, there are no aging effects that would result from the Nylon 11 tubing contacting the air-indoor and air/gas environments inside the Control Building.

The staff reviewed the applicant's response and noted that Nylon 11 material is highly resistant to corrosion and can withstand temperatures from -40 °F to 200 °F. The staff acknowledges that the use of Nylon 11 material for flexible tubing in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation. On the basis that the Nylon 11 tubing is located in the Control Building in an environment that does not exceed 80 °F and a non-radioactive atmosphere, the staff finds that Nylon 11 tubing will not have any aging effects requiring management in air-indoor and air/gas environments in the fire protection system.

Based on its review, the staff finds the applicant's response to RAI 3.3.2.3-1 acceptable because the use of Nylon 11 material for flexible tubing in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation and because the Nylon 11 tubing is located in the Control Building in an environment that does not exceed 80 °F and a non-radioactive atmosphere, and therefore, there will be no aging effects requiring management in air-indoor and air/gas environments in the fire protection system. The staff's concern described in RAI 3.3.2.3-1 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-10, the applicant proposed to manage loss of material due to pitting and crevice corrosion for aluminum alloy material for water motor alarms exposed to an air with borated water leakage (external) environment using the External Surfaces Monitoring Program. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff confirmed for these AMR line items in LRA Table 3.2.2-10, in which the applicant listed the environment as air with borated water leakage, that for the same system, component, material and environment combination, the applicant manages loss of material due to boric acid corrosion with the "Boric Acid Corrosion Program," as recommend by GALL. The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Sections 3.0.3.2.16. The staff determined that the External Surfaces Monitoring Program which includes periodic visual inspections of external surfaces performed during system walkdowns, are adequate to manage loss of material due to general, pitting and crevice corrosion for aluminum alloy components exposed to air with borated water leakage environment addressed by this AMR.

On the basis of periodic visual inspections being performed during system walkdowns of these components by the External Surfaces Monitoring Program, and the applicant monitoring these components with the Boric Acid Corrosion Program, for loss of material due to boric acid corrosion, the staff finds the applicant's use of the External Surfaces Monitoring Program acceptable.

In LRA Table 3.3.2-10, the applicant proposed to manage loss of material/general, pitting and crevice corrosion, loss of material/microbiologically-influenced corrosion, and loss of preload/thermal effects, gasket creep, and self loosening for carbon and low alloy steel and ductile cast iron mechanical closure bolting in a soil (external) environment using the Bolting Integrity Program for six line items. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material.

The staff reviewed the applicant's Bolting Integrity Program and its evaluation is documented in SER Section 3.0.3.1.3. The LRA states that this program manages the loss of material due to general, pitting and crevice corrosion, MIC, and loss of preload due to thermal effects, gasket creep, and self-loosening. The staff found that the aging effects are managed through the implementation of procedures which follow NRC approved guidance. Additionally, this environment consists of a mixture of inorganic materials produced by the weathering of rocks and clays, and organic material produced by the decomposition of vegetation. Water content, pH, ion exchange capacity, density, and permeability of the soil can affect degradation kinetics. TMI inspects for loss of preload using methods including inspecting for leakage indicating loss of preload, and for loose bolts, MIC and loss of material are also managed by the Bolting Integrity Program at a frequency defined by ASME B&PV Code, Section XI, Table IWB 2500-1, IWC 2500-1, and IWD 2500-1. Therefore, the staff concludes that the management of loss of material due to general, pitting and crevice corrosion, microbiologically-influenced corrosion and loss of preload due to thermal effects, gasket creep, and self-loosening of carbon and low alloy steel bolting and ductile cast iron mechanical closure bolting externally exposed to soil environment is acceptable.

In LRA Table 3.3.2-10, the applicant proposed to manage loss of preload/thermal effects, gasket creep, and self loosening for carbon and low alloy steel and ductile cast iron mechanical closure bolting in an outdoor air (external) environment using the Bolting Integrity Program for two line items. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff reviewed the applicant's Bolting Integrity Program and its evaluation is documented in SER Section 3.0.3.1.3. The LRA states that this program manages the loss of material due to general, pitting and crevice corrosion, MIC and loss of preload due to thermal effects, gasket creep, and self-loosening. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance. Additionally, the LRA line items are similar to GALL Items VIII.H-4, and VIII.H-5, which accounts for an air-indoor uncontrolled (external) environment, but not an air-outdoor (external) environment. This environment consists of moist air, exposure to weather, precipitation, and wind. TMI-1 inspects for loss of preload using methods including inspecting for leakage indicating loss of preload, and for loose bolts. The staff concludes that the management of loss of preload/thermal effects, gasket creep, and self loosening for carbon and low alloy steel and ductile cast iron mechanical closure bolting in an outdoor air (external) environment is acceptable.

In LRA Table 3.3.2-10 the applicant designated Note H for stainless steel piping and fittings exposed to a soil (external) environment in the fire protection system because the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. The staff reviewed the GALL Report and concluded that the AMR line item, piping and fittings is not evaluated for a soil (external) environment for loss of material due to MIC. The applicant credits the Buried Piping and Tanks Inspection Program for managing loss of material due MIC.

The staff reviewed the Buried Piping and Tanks Inspection Program and its evaluation is documented in SER Section 3.0.3.2.15. It was noted by the staff that this program provides for opportunistic and focused excavations of stainless steel piping and fittings during the last ten years of the current license period and within ten years of the commencement of the period of extended operation. Inspection of the exposed piping will determine if microbiologically-influenced corrosion is causing loss of material. Unacceptable degradation will be corrected through the applicant's Corrective Action Program. The staff concluded that loss of material due to microbiologically-influenced corrosion will be adequately managed through the period of extended operation because piping will be subject to inspection that will detect loss of material such that any unacceptable degradation will be corrected.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.11 Auxiliary Systems – Fuel Handling and Fuel Storage System – Summary of Aging Management Evaluation – LRA Table 3.3.2-11

The staff reviewed LRA Table 3.3.2-11, which summarizes the results of AMR evaluations for the fuel handling and fuel storage system component groups.

In LRA Table 3.3.2-11, the applicant stated that for Tygon® hoses in air with borated water external and treated water internal environments, there are no aging effects requiring management. The applicant referenced footnote "F" stating that this material is not listed in the GALL Report for this environment.

In RAI 3.3.2.3-1, dated October 16, 2008, the staff requested that the applicant provide additional information to justify why there are no aging effects requiring management for Tygon material. In its response to the RAI dated November 12, 2008 , the applicant stated the following:

> The Tygon tubing is used inside the Auxiliary Building as a sight hose for the fuel transfer tube drain line. Tygon tubing is made from PVC and it has excellent chemical resistance to water and to acids, including boric acid. Tygon tubing has a maximum recommended operating temperature of 165 °F and has a radiation damage threshold of 5 x 10^5 rads. The design temperature for the Auxiliary Building is 104 °F and the maximum radiation level at the service location is 1.3 x 10^4 rads in 60 years. Therefore, there are no aging effects that would result from using Tygon tubing inside the Auxiliary Building where it contacts the treated water (internal) environment and the air with borated water leakage (external) environment.

The staff reviewed the applicant response and industry documents related to Tygon material. The staff noted that Tygon material is made from PVC and is highly resistant to corrosion and can withstand temperatures up to 165 °F. The staff acknowledges that the use of Tygon material for flexible tubing in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation. On the basis that the Tygon tubing is located in the Auxiliary Building in an environment that does not exceed 104 °F and radioactive atmosphere that does not exceed 1.3 x 10^4 rads, the staff finds that Tygon tubing will not have any aging effects requiring management in air with boric acid leakage and treated water environments in the fuel handling and fuel storage system.

Based on its review, the staff finds the applicant's response to RAI 3.3.2.3-1 acceptable because the use of Tygon tubing in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation and because the Tygon tubing is located in the auxiliary building in an environment that does not exceed 104 °F and radioactive atmosphere that does not exceed 1.3 x 10^4 rads, the Tygon tubing will not have any aging effects requiring management in air with boric acid leakage and treated water environments in the fuel handling and fuel storage system. The staff's concern described in RAI 3.3.2.3-1 is resolved.

In LRA Table 3.3.2-11, the applicant proposed to manage loss of preload/thermal effects, gasket creep, and self loosening of stainless steel bolting externally exposed to air with borated water leakage and treated water environments using the Bolting Integrity Program for two line items. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material.

The staff reviewed the applicant's Bolting Integrity Program and its evaluation is documented in SER Section 3.0.3.1.3. The LRA states that this program manages the loss of material due to general, pitting and crevice corrosion, MIC and loss of preload due to thermal effects, gasket creep, and self-loosening. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance. Additionally, the two LRA line items are similar to GALL Item VIII.H-5, which accounts for an air-indoor uncontrolled (external) environment, but not an air with borated water leakage (external) or treated water (external) environment. Both of these environments are potentially contaminated and could make the detection of loss of preload more difficult, as detection of leakage, one of the methods for detecting loss of preload, will be difficult to identify in these wet environments. However, TMI inspects for loss of preload using other methods as well, including inspecting for loose bolts. Therefore, the staff concludes that the management of loss of preload/thermal effects, gasket creep, and self loosening of stainless steel bolting externally exposed to air with borated water leakage and treated water environments is acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-11, the applicant proposed to manage loss of material/general, pitting and crevice corrosion for carbon steel crane/hoist (aux fuel handling bridge), crane/hoist (main fuel handling bridge), crane/hoist (rails), and the crane/hoist (spent fuel handling bridge) externally exposed to an air with borated water leakage environment using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program for four AMR line items. The AMR line items cite Generic Note E, which indicates that the material, aging effect, and environment are consistent with the GALL Report, however, a different aging management program is credited.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is documented in SER Section 3.0.3.2.7. The LRA states that this program manages the effects of general corrosion on the crane and trolley structural components and the effects of wear on the rails in the rail system. Inspection frequency is annually for cranes and hoists that are accessible during plant operation and every two years for cranes and hoists that are only accessible during refueling outages. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance, and inspected using visual techniques. Therefore, the staff concludes that the management of loss of material/general, pitting and crevice corrosion for carbon steel crane/hoist (aux fuel handling bridge), crane/hoist (main fuel handling bridge), crane/hoist (rails), and the crane/hoist (spent fuel handling bridge) externally exposed to an air with borated water leakage environment is acceptable.

In LRA Table 3.3.2-11, the applicant proposed to manage loss of material/wear for stainless steel crane/hoist (rails) externally exposed to an air with borated water leakage environment using the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material.

The staff reviewed the applicant's Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program and its evaluation is documented in SER Section 3.0.3.2.7. The LRA states that this program manages the effects of general corrosion on the crane and trolley structural components and the effects of wear on the rails in the rail system. Inspection frequency is annually for cranes and hoists that are accessibly during plant operation and every two years for cranes and hoists that are only accessible during refueling outages. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance, and inspected using visual techniques. Therefore, the staff concludes that the management of loss of material/wear for stainless steel crane/hoist (rails) externally exposed to an air with borated water leakage environment is acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.12 Auxiliary Systems – Fuel Oil System – Summary of Aging Management Evaluation – LRA Table 3.3.2-12

The staff reviewed LRA Table 3.3.2-12, which summarizes the results of AMR evaluations for the fuel oil system component groups.

In LRA Table 3.3.2-12, the applicant proposed to manage loss of preload/thermal effects, gasket creep, and self loosening for carbon and low alloy steel mechanical closure bolting in an outdoor air (external) environment using the Bolting Integrity Program. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff reviewed the applicant's Bolting Integrity Program and its evaluation is documented in SER Section 3.0.3.1.3. The applicant states in the LRA that this program manages the loss of material due to general, pitting and crevice corrosion, MIC and loss of preload due to thermal effects, gasket creep, and self-loosening. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance. Additionally, the LRA line item is similar to GALL Item VII.I-5, which accounts for an air-indoor uncontrolled (external) environment, but not an air-outdoor (external) environment. This environment consists of moist air, exposure to weather, precipitation, and wind. TMI-1 inspects for loss of preload using methods including inspecting for leakage indicating loss of preload, and for loose bolts. The staff concludes that the management of loss of preload/thermal effects, gasket creep, and self loosening for carbon and low alloy steel mechanical closure bolting in an outdoor air (external) environment is acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.13 Auxiliary Systems – Hydrogen Monitoring – Summary of Aging Management Evaluation – LRA Table 3.3.2-13

The staff reviewed LRA Table 3.3.2-13, which summarizes the results of AMR evaluations for the hydrogen monitoring component groups. For stainless steel piping and fittings, and stainless steel valve bodies, with an intended function of pressure boundary in an air/gas wetted (internal) environment, the applicant indicated no aging effect requiring management and no aging management program. These line items reference Note G and plant-specific Note 1, which states the following: "The internal environment for this component is air/gas (wetted), however pooling of condensation would not be present because the lines are sloped to prevent pooling per Drawing LR-302-674. Stainless steel in an air/gas internal environment without the potential for pooling condensation is equivalent to stainless steel in an air - indoor uncontrolled environment, and no aging effects are predicted for this combination per NUREG-1801, Item VII.J-15."

The staff reviewed the GALL Report and confirmed that no aging effects are predicted for stainless steel piping, piping components, and piping elements exposed to air in an indoor uncontrolled (external) environment. The staff reviewed the LRA and confirmed that line item 3.3.1-94 for stainless steel piping, piping components, and piping elements exposed to air in an indoor uncontrolled (external) environment is consistent with the GALL Report, Item VII.J-15. The staff agrees with the applicant's determination that that the two line items in LRA Table 3.3.2-13 referencing Note G, and plant-specific Note 1 are equivalent to GALL Report, Item VII.J-15, because pooling of condensation would not occur because the lines are sloped and that no aging effect is predicted and no aging management program is required.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.14 Auxiliary Systems – Instrument and Control Air System – Summary of Aging Management Evaluation – LRA Table 3.3.2-14

The staff reviewed LRA Table 3.3.2-14, which summarizes the results of AMRs for the instrument and control air system component groups.

In LRA Table 3.3.2-14, the applicant proposed to manage reduction of heat transfer due to fouling of copper alloy with less than 15% Zinc heat exchanger components in an air/gas wetted internal environment by using the Compressed Air Monitoring Program. The applicant referenced footnote "G" for this line item indicating that the environment is not listed in the GALL Report for this material and component combination.

The staff reviewed the Compressed Air Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.8. The staff finds that during disassembly, the internals of the aftercoolers are accessible and can be visually inspected and any fouling would be observed and identified for further corrective actions. Based on this review, the staff finds that the Compressed Air Monitoring Program will adequately manage reduction of heat transfer due to fouling of copper alloy with less than 15% Zinc heat exchanger components in an air/gas wetted internal environment through the period of extended operation because periodic inspection is performed to detect any signs of degradation before loss of intended function.

In LRA Table 3.3.2-14, the applicant proposed to manage loss of material due to pitting and crevice corrosion for aluminum material for filter housing exposed to an air with borated water leakage (external) environment using the External Surfaces Monitoring Program. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff confirmed for these AMR line items in LRA Table 3.2.2-14, in which the applicant listed the environment as air with borated water leakage, that for the same system, component, material and environment combination, the applicant manages loss of material due to boric acid corrosion with the Boric Acid Corrosion Program, as recommend by the GALL Report. The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Sections 3.0.3.2.16. The staff determined that the External Surfaces Monitoring Program which includes periodic visual inspections of external surfaces performed during system walkdowns, are adequate to manage loss of material due to general, pitting and crevice corrosion for aluminum components exposed to air with borated water leakage environment addressed by this AMR. On the basis of periodic visual inspections being performed during system walkdowns of these components by the External Surfaces Monitoring Program, and the applicant monitoring these components with the Boric Acid Corrosion Program, for loss of material due to boric acid corrosion, the staff finds the applicant's use of the External Surfaces Monitoring program acceptable.

In LRA Table 3.3.2-14, the applicant proposed to manage loss of preload/thermal effects, gasket creep, and self loosening for stainless steel mechanical closure bolting in an indoor air (external) and air with borated water leakage (external) environment using the Bolting Integrity Program for two AMR line items. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff reviewed the applicant's Bolting Integrity Program and its evaluation is documented in SER Section 3.0.3.1.3. The LRA states that this program manages the loss of material due to general, pitting and crevice corrosion, MIC and loss of preload due to thermal effects, gasket creep, and self-loosening. The staff found that the aging effects are managed through the implementation of procedures that follow NRC approved guidance. Additionally the LRA line items are similar to GALL item VIII.H-5, which accounts for an air-indoor uncontrolled (external) environment, but not an air-indoor (external) or air with borated water leakage (external) environment. Air-indoor is considered by the GALL to be synonymous with air-indoor uncontrolled. The air with borated water leakage (external) environment consists of water from leakage which is considered to be untreated, due to the potential for water contamination. TMI-1 inspects for loss of preload using methods including inspecting for leakage indicating loss of preload, and for loose bolts. The staff concludes that the management of loss of preload/thermal effects, gasket creep, and self loosening for stainless steel mechanical closure bolting in an indoor air (external) and air with borated water leakage (external) environment is acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.15 Auxiliary Systems – Intake Screen and Pump House Ventilation System – Summary of Aging Management Evaluation – LRA Table 3.3.2-15

The staff reviewed LRA Table 3.3.2-15, which summarize the results of AMR evaluations for the intake screen and pump house ventilation system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.16 Auxiliary Systems – Intermediate Building Ventilation System – Summary of Aging Management Evaluation – LRA Table 3.3.2-16

The staff reviewed LRA Table 3.3.2-16, which summarize the results of AMR evaluations for the intermediate building ventilation system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.17 Auxiliary Systems – Liquid and Gas Sampling System – Summary of Aging Management Evaluation – LRA Table 3.3.2-17

The staff reviewed LRA Table 3.3.2-17, which summarize the results of AMR evaluations for the liquid and gas sampling system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.18 Auxiliary Systems – Miscellaneous Floor and Equipment Drain System – Summary of Aging Management Evaluation – LRA Table 3.3.2-18

The staff reviewed LRA Table 3.3.2-18, which summarizes the results of AMRs for the miscellaneous floor and equipment drain system component groups.

In LRA Table 3.3.2-18, the applicant stated that for organic polymer floor sumps in air/gas – wetted internal, concrete embedded, air with borated water leakage external and raw water internal environments there are no aging effects requiring management. The applicant referenced footnote "F" stating that this material is not listed in the GALL Report for these environments.

In RAI 3.3.2.3-1, dated October 16, 2008, the staff requested that the applicant provide additional information identifying what polymer material is used and to justify why there are no aging effects requiring management for this material.

In its response to the RAI dated November 12, 2008, the applicant stated the following:

> These line items refer to a fiberglass liner used inside the Tendon Access Gallery Sump. Fiberglass is a composite material comprised of glass fibers and a polyester or epoxy resin. Fiberglass composites have excellent moisture resistance and chemical resistance to many corrosive materials, including acids (specifically including boric acid), chlorides, nitrates, and sulfates. The maximum recommended operating temperature for fiberglass is

200 °F. The average normal operating temperature of the tendon access gallery is 85 °F and the radiation level is negligible. Therefore, there are no aging effects resulting from using the fiberglass sump liner inside the tendon access gallery where it contacts concrete, air with borated water leakage, air-gas wetted and raw water environments.

The staff reviewed the applicant's response and noted that fiberglass piping and liners provide excellent corrosion resistance, combined with high temperature and pressure capabilities, and it is impervious to normal plant environments. The staff acknowledges that the use of fiberglass lining inside the gallery sump in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation. On the basis that the fiberglass liner is located in the tendon access gallery sump in an environment that does not exceed 85°F and the radioactivity level is negligible, the staff finds that the fiberglass piping and liner will not have any aging effects requiring management in concrete, air with borated water leakage, air-gas wetted and raw water environments in the fuel handling and fuel storage system.

Based on its review, the staff finds the applicants response to RAI 3.3.2.3-1 acceptable because the use of fiberglass piping and lining inside the gallery sump in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation and because the fiberglass piping and liner is located in the tendon access gallery sump in an environment that does not exceed 85°F and the radioactivity level is negligible, the fiberglass piping and liner will not have any aging effects requiring management in concrete, air with borated water leakage, air-gas wetted and raw water environments in the fuel handling and fuel storage system. The staff's concern described in RAI 3.3.2.3-1 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.19 Auxiliary Systems – Open Cycle Cooling Water System – Summary of Aging Management Evaluation – LRA Table 3.3.2-19

The staff reviewed LRA Table 3.3.2-19, which summarize the results of AMR evaluations for the open cycle cooling water system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.20 Auxiliary Systems – Radiation Monitoring System – Summary of Aging Management Evaluation – LRA Table 3.3.2-20

The staff reviewed LRA Table 3.3.2-20, which summarize the results of AMR evaluations for the radiation monitoring system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.21 Auxiliary Systems – Radwaste System – Summary of Aging Management Evaluation – LRA Table 3.3.2-21

The staff reviewed LRA Table 3.3.2-21, which summarize the results of AMR evaluations for the radwaste system component groups.

In LRA Table 3.3.2-21, the applicant proposed to manage cracking due to stress corrosion cracking for stainless steel material for piping, fittings, eductors, heat exchanger components, pump casing, rupture disks, strainer body, tanks, thermowell and valve body components exposed to an internal environment of raw water greater than 140°F using the Internal Inspection of Miscellaneous Piping and Ducting Components. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material combination.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff noted that the applicant's proposed program will supplement its period visual inspections with volumetric testing to specifically manage cracking due to stress corrosion cracking in stainless steel components for indication of degradation. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities and during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections and then supplemented by volumetric test for stainless steel components to detect the aging effect of cracking due to stress corrosion cracking when exposed to an internal environment of raw water greater than 140°F they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

In LRA Table 3.3.2-21, the applicant proposed to manage loss of material due to microbiologically-influenced corrosion for copper alloy (with 15% zinc or more and with less than 15% zinc) material for pump casing, sight glasses and valve body components exposed to an internal lubricating oil environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities and during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspection, they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

In LRA Table 3.3.2-21, the applicant proposed to manage loss of material due to microbiologically-influenced corrosion and fouling for nickel alloy material for piping and fitting components exposed to an internal raw water environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities and during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections when exposed to an internal environment of raw water they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

In LRA Table 3.3.2-21, the applicant proposed to manage loss of material due to pitting and crevice corrosion for nickel alloy material for piping and fitting components exposed to an internal treated water environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material combination. The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities and during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections, they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

In LRA Table 3.3.2-21, the applicant proposed to manage loss of material due to crevice corrosion and fouling for titanium alloy material for tanks exposed to an internal raw water greater than 140°F environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The AMR line items cite Generic Note F, which indicates that the material is not addressed in the GALL Report for this environment.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities and during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections, they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

In LRA Table 3.3.2-21, the applicant proposed to manage loss of material due to pitting and crevice corrosion for titanium alloy material for tanks exposed to an internal treated water greater than 140° F environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program. The AMR line items cite Generic Note F, which indicates that the material is not addressed in the GALL Report for this environment.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections, they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

In LRA Table 3.3.2-21, the applicant stated that for glass flow device and sight glasses in air with borated water leakage external environment there are no aging effects requiring management. The applicant referenced footnote "G" for this line item indicating that the environment is not listed in the GALL Report for this material and component combination.

As indicated in "Corrosion Handbook" by H.H.Uhlig, the staff noted that glass as a material is impervious to normal plant environments. This conclusion is based on industry experience where the staff noted that no failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at temperatures or during time periods of concern for extended operation. The staff acknowledges that the use of glass in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation, since air with borated water leakage external environment does not contain hydroflouric acid or caustics. The staff reviewed the GALL Report and noted that item VII.J-12 indicates that glass in a treated borated water environment has no aging effects that require aging management. On the basis that air with borated water leakage is a less aggressive environment than treated borated water, the staff finds that glass in an air with borated water leakage will not have any aging effects requiring aging management.

In LRA Table 3.3.2-21, the applicant stated that for titanium alloy tanks in air with borated water leakage external environment there are no aging effects requiring management. The applicant referenced footnote "F" for this line item indicating that material is not listed in the GALL Report for this component and environment combination.

In RAI 3.3.2.3-1, dated October 16, 2008, the staff requested that the applicant provide additional information to justify why there are no aging effects requiring management for titanium alloy material.

In its response to the RAI dated November 12, 2008, the applicant stated the following:

> Titanium offers outstanding resistance to a wide variety of environments, including oxidizing, neutral, and inhibited reducing conditions. It also remains passive under mildly reducing conditions. Titanium is not susceptible to boric acid acorrosion, based upon corrosion testing performed by the titanium manufacturer. Based on these material

properties, titanium is not susceptible to aging effects in the air with borated water leakage environment.

The staff noted that as shown in the "Metals Handbook," Ninth Edition, Volume 13, the corrosion resistance of titanium is a result of the formation of a continuous, stable, highly-adherent protective oxide layer on the metal surface. The staff noted that the metal itself, very reactive with a high affinity for oxygen, reforms damage to this layer instantaneously. The staff also noted that no failure due to an aging effect of titanium components in normal plant environments has been recorded in industry. Based on this review, the staff finds the applicant's response acceptable, and finds that titanium alloy tanks in air with borated water leakage external environment will not have any aging effects requiring management.

The staff noted that for nickel alloy piping and fittings exposed to an air with borated water leakage (external) environment, the applicant assigned no aging effect and therefore no aging management program was assigned for these component/material/environment combinations.

The staff noted that austenitic materials such as nickel alloys are not subject to loss of material or cracking when subjected to this environment and these materials are used as corrosion resistant replacement materials where other materials have degraded. According to EPRI NP-5769, "Degradation and Failure of Bolting in Nuclear Power Plants, Volumes 1 and 2," April 1988, corrosion resistant materials such as austenitic and martensitic stainless steels and high strength nickel base alloys offer good protection against boric acid corrosion. Therefore, the staff finds that no aging management program is necessary for nickel alloys in the air with borated water leakage (external) environment.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.22 Auxiliary Systems – Service Building Chilled Water System – Summary of Aging Management Evaluation – LRA Table 3.3.2-22

The staff reviewed LRA Table 3.3.2-22, which summarize the results of AMR evaluations for the service building chilled water system component groups.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1. The staff's evaluation of the line item with Note I is documented in SER Section 3.3.2.1.15.

3.3.2.3.23 Auxiliary Systems – Spent Fuel Cooling System – Summary of Aging Management Evaluation – LRA Table 3.3.2-23

The staff reviewed LRA Table 3.3.2-23, which summarize the results of AMR evaluations for the spent fuel cooling system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.24 Auxiliary Systems – Station Blackout and UPS Diesel Generator Systems – Summary of Aging Management Evaluation – LRA Table 3.3.2-24

The staff reviewed LRA Table 3.3.2-24, which summarize the results of AMR evaluations for the station blackout and UPS diesel generator systems component groups.

In LRA Table 3.3.2-24, the applicant proposed to manage reduction of heat transfer due to fouling for carbon steel material for heat exchanger components exposed to an internal dry air/gas environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires periodic visual inspections of internal surfaces during periodic system and component surveillance activities and during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff further noted that these periodic visual inspections are adequate to manage reduction of heat transfer due to fouling for these components exposed to internal dry air/gas environment addressed by this AMR because a visual inspection will be capable of detecting any fouling (build up from whatever source) on the surface of these components. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections when exposed to an internal dry air/gas they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

In LRA Table 3.3.2-24 the applicant designated Generic Note H for copper alloy piping and fittings exposed to a lubricating oil environment in the station blackout and UPS diesel generator systems (Table 3.3.2-24) because the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report for heat exchanger components and the staff reviewed the GALL Report and concluded that the AMR line item, copper alloy piping and fittings is not evaluated for lubricating oil for loss of material due to pitting, crevice, microbiologically-influenced corrosion. The applicant credits the Lubricating Oil Analysis Program and the One-time Inspection Program for managing loss of material due to pitting, crevice, and microbiologically-influenced corrosion. The staff's evaluation of the Lubricating Oil Analysis Program and the One-time Inspection Program is documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff noted that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting, crevice and microbiologically-influenced corrosion and 2) will require one-time inspection of select susceptible components exposed to lubricating oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion to verify the effectiveness of the Lubricating Oil Analysis Program. The staff noted that the one-time inspection is an acceptable method to determine whether or not loss of material is occurring slowly such that the intended function will be maintained during the period of extended operation. On this basis, the staff finds that the Lubricating Oil Analysis Program and the One-Time Inspection Program are adequate to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion for these copper alloy components through the period of extended operation.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.25 Auxiliary Systems – Water Treatment and Distribution System – Summary of Aging Management Evaluation – LRA Table 3.3.2-25

The staff reviewed LRA Table 3.3.2-25, which summarize the results of AMR evaluations for the water treatment and distribution system component groups.

In LRA Table 3.3.2-25, the applicant proposed to manage cracking due to stress corrosion cracking for stainless steel material for pump casings exposed to an internal environment of raw water greater than 140°F using the Internal Inspection of Miscellaneous Piping and Ducting Components Program. The AMR line items cite Generic Note G, which indicates that the environment is not addressed in the GALL Report for this component and material combination.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff noted, that the applicant's proposed program will supplement its periodic visual inspections with volumetric testing to specifically manage cracking due to stress corrosion cracking in stainless steel components for indications of degradation. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program performs periodic visual inspections of internal surfaces during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections and then supplemented by volumetric test for stainless steel components to detect the aging effect of cracking due to stress corrosion cracking when exposed to an internal environment of raw water greater than 140°F they will be adequately managed by the Inspection of Miscellaneous Piping and Ducting Components Program.

In LRA Table 3.3.2-25, the applicant stated that for PVC piping and fittings in raw water, treated water and air-indoor environments there are no aging effects requiring management. The applicant referenced footnote "F" for this line item indicating that material is not listed in the GALL Report for this component and environment combination.

As identified in "Engineering Materials Handbook – Engineering Plastics," the staff noted that PVC is unaffected by water, concentrated alkalis, non-oxidizing acids, oils, ozone, sunlight, or humidity changes. The staff also noted that unlike metals, thermoplastics do not display corrosion rates, and rather than depend on an oxide layer for protection, they depend on chemical resistance to the environments to which they are exposed. The use of thermoplastics in power plant environments is a design-driven criterion. The staff acknowledges that plastic is an impervious material and once selected for the environment will not have any significant age related degradation. The staff has not observed any age related industry experience for plastic material in raw water, treated water and air-indoor environments. Based on this review, the staff finds that raw water, treated water and air-indoor environments on PVC materials will not result in aging effects that will be of concern during the period of extended operation.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.3 Conclusion

The staff concludes that the applicant has provided sufficient information to demonstrate that the effects of aging for the Auxiliary System components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4 Aging Management of Steam and Power Conversion System

This section of the SER documents the staff's review of the applicant's AMR results for the steam and power conversion system components and component groups of the following:

- Condensate System
- Condensers and Air Removal System
- Emergency Feed water System
- Extraction Steam System
- Feed water System
- Main Generator and Auxiliary Systems
- Main Steam System
- Steam Turbine and Auxiliary Systems

3.4.1 Summary of Technical Information in the Application

LRA Section 3.4 provides AMR results for the steam and power conversion system components and component groups. In LRA Table 3.4.1, "Summary of Aging Management Evaluations for Steam and Power Conversion," the applicant provided a summary comparison of its AMRs to those evaluated in the GALL Report for steam and power conversion system components and component groups.

The applicant's AMRs evaluated and incorporated plant-specific and industry operating experience in the determination of AERMs from plant-specific condition reports and discussions with site personnel and from the GALL Report and issues identified since its publication.

3.4.2 Staff Evaluation

The staff reviewed LRA Section 3.4 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging for steam and power conversion system components within the scope of license renewal and subject to an AMR, will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff conducted an onsite audit of AMPs to ensure the applicant's claim that certain AMPs were consistent with the GALL Report. The purpose of this audit was to examine the applicant's AMPs and related documentation and to verify the applicant's claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff's evaluations of the AMPs are documented in SER Section 3.0.3.

The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Section 3.4.2.1 and 3.4.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff's evaluation are discussed in SER Section 3.4.2.3.

For components which the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's operating experience to verify the applicant's claims.

Table 3.4-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.4 and addressed in the GALL Report.

Table 3.4-1 Staff Evaluation for Steam and Power Conversion Systems Components in the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping, piping components, and piping elements exposed to steam or treated water (3.4.1-1)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.4.2.2.1)
Steel piping, piping components, and piping elements exposed to steam (3.4.1-2)	Loss of material due to general, pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.2)
Steel heat exchanger components exposed to treated water (3.4.1-3)	Loss of material due to general, pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.2)
Steel piping, piping components, and piping elements exposed to treated water (3.4.1-4)	Loss of material due to general, pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection, or Closed-Cycle Cooling Water System	Consistent with GALL Report (See SER Section 3.4.2.2.2)
Steel heat exchanger components exposed to treated water (3.4.1-5)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.2.)
Steel and stainless steel tanks exposed to treated water (3.4.1-6)	Loss of material due to general (steel only) pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry One-Time Inspection Closed-Cycle Cooling Water	Consistent with GALL Report (See SER Section 3.4.2.2.2)

Component Group (GALL Report Item No.)	Aging Effect/Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel piping, piping components, and piping elements exposed to lubricating oil (3.4.1-7)	Loss of material due to general, pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis One-Time Inspection of steel heat exchanger components See GALL Report Item No. 3.4.1-12 below.	Not applicable to TMI-1. (See SER Section 3.4.2.2.5)
Steel piping, piping components, and piping elements exposed to raw water (3.4.1-8)	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling	Plant specific	Yes	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL Report (See SER Section 3.4.2.2.3)
Stainless steel and copper alloy heat exchanger tubes exposed to treated water (3.4.1-9)	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.4)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil (3.4.1-10)	Reduction of heat transfer due to fouling	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis One-Time Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.4)
Buried steel piping, piping components, piping elements, and tanks (with or without coating or wrapping) exposed to soil (3.4.1-11)	Loss of material due to general, pitting, crevice, and micro biologically-influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	No Yes	Buried Piping and Tanks Inspection program	Consistent with GALL Report (See SER Section 3.4.2.2.5)
Steel heat exchanger components exposed to lubricating oil (3.4.1-12)	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Lubricating Oil Analysis and One-Time Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.5)

Component Group (GALL Report Item No.)	Aging Effect/Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel piping, piping components, piping elements exposed to steam (3.4.1-13)	Cracking due to stress corrosion cracking	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to TMI-1. (See SER Section 3.4.2.2.6.)
Stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water > 60°C (> 140°F) (3.4.1-14)	Cracking due to stress corrosion cracking	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.6)
Aluminum and copper alloy piping, piping components, and piping elements exposed to treated water (3.4.1-15)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.7)
Stainless steel piping, piping components, and piping elements; tanks, and heat exchanger components exposed to treated water (3.4.1-16)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry One-Time Inspection Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL Report (See SER Section 3.4.2.2.7)
Stainless steel piping, piping components, and piping elements exposed to soil (3.4.1-17)	Loss of material due to pitting and crevice corrosion	Plant specific	Yes	Buried Piping and Tanks Inspection program	Consistent with GALL Report (See SER Section 3.4.2.2.7)
Copper alloy piping, piping components, and piping elements exposed to lubricating oil (3.4.1-18)	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis and One-Time Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.7)
Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil (3.4.1-19)	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis One-Time Inspection Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL (See SER Section 3.4.2.2.8)

Component Group (GALL Report Item No.)	Aging Effect/Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel tanks exposed to air - outdoor (external) (3.4.1-20)	Loss of material, general, pitting, and crevice corrosion	Aboveground Steel Tanks	No	Above ground Steel Tanks	Consistent with GALL Report
High-strength steel closure bolting exposed to air with steam or water leakage (3.4.1-21)	Cracking due to cyclic loading, stress corrosion cracking	Bolting Integrity	No	Not applicable	Not Applicable to TMI-1 (See SER Section 3.4.2.1.1)
Steel bolting and closure bolting exposed to air with steam or water leakage, air - outdoor (external), or air - indoor uncontrolled (external); (3.4.1-22)	Loss of material due to general, pitting and crevice corrosion; loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	External Surfaces Monitoring Program Bolting Integrity Program	Consistent with GALL Report (See SER Section 3.4.2.1.2)
Stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water > 60°C (> 140°F) (3.4.1-23)	Cracking due to stress corrosion cracking	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to TMI-1. (See SER Section 3.4.2.1.1)
Steel heat exchanger components exposed to closed cycle cooling water (3.4.1-24)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.4.2.1.1)
Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water (3.4.1-25)	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.4.2.1.1)
Copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water (3.4.1-26)	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.4.2.1.1)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed cycle cooling water (3.4.1-27)	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.4.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel external surfaces exposed to air - indoor uncontrolled (external), condensation (external), or air outdoor (external) (3.4.1-28)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to steam or treated water (3.4.1-29)	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	Flow-Accelerated Corrosion	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to air outdoor (internal) or condensation (internal) (3.4.1-30)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Consistent with GALL Report
Steel heat exchanger components exposed to raw water (3.4.1-31)	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System	Consistent with GALL Report.
Stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water (3.4.1-32)	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.4.2.1.1)
Stainless steel heat exchanger components exposed to raw water (3.4.1-33)	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion, and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System	Consistent with GALL Report.
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to raw water (3.4.1-34)	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System	Consistent with GALL Report
Copper alloy > 15% Zn piping, piping components, and piping elements exposed to closed cycle cooling water, raw water, or treated water (3.4.1-35)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching	Consistent with GALL Report

Component Group (GALL Report Item No.)	Aging Effect/Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Gray cast iron piping, piping components, and piping elements exposed to soil, treated water, or raw water (3.4.1-36)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching	Consistent with GALL Report
Steel, stainless steel, and nickel-based alloy piping, piping components, and piping elements exposed to steam (3.4.1-37)	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	Water Chemistry	Consistent with GALL Report
Steel bolting and external surfaces exposed to air with borated water leakage (3.4.1-38)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Boric Acid Corrosion	Consistent with GALL Report
Stainless steel piping, piping components, and piping elements exposed to steam (3.4.1-39)	Cracking due to stress corrosion cracking	Water Chemistry	No	Water Chemistry	Consistent with GALL Report
Glass piping elements exposed to air, lubricating oil, raw water, and treated water (3.4.1-40)	None	None	No	None	Consistent with GALL Report
Stainless steel, copper alloy, and nickel alloy piping, piping components, and piping elements exposed to air - indoor uncontrolled (external) (3.4.1-41)	None	None	No	None	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to air - indoor controlled (external) (3.4.1-42)	None	None	No	None	Not applicable to TMI-1 (See SER Section 3.4.2.1.1)
Steel and stainless steel piping, piping components, and piping elements in concrete (3.4.1-43)	None	None	No	None	Consistent with GALL Report

Component Group (GALL Report Item No.)	Aging Effect/Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel, stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas (3.4.1-44)	None	None	No	None	Consistent with GALL Report

The staff's review of the steam and power conversion system component groups followed several approaches. One approach, documented in SER Section 3.4.2.1, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.4.2.2, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.4.2.3, discusses the staff's review of AMR results for components the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the steam and power conversion system components is documented in SER Section 3.0.3.

3.4.2.1 AMR Results That Are Consistent with the GALL Report

LRA Section 3.4.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the steam and power conversion system components:

- Aboveground Steel Tanks
- Bolting Integrity
- Boric Acid Corrosion
- Buried Piping and Tanks Inspection
- External Surfaces Monitoring
- Flow Accelerated Corrosion
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
- Lubricating Oil Analysis
- One-time Inspection
- Open Cycle Cooling Water System
- Selective Leaching of Materials
- TLAA
- Water Chemistry

LRA Tables 3.4.2-1 through 3.4.2-8 summarize the AMRs for the steam and power conversion system components and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant had claimed consistency and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant specific components in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item. The notes describe how the information in the tables aligns with the information in the GALL Report. The staff audited those AMRs with Notes A through E, which indicate how the AMR was consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff audited these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and confirmed that it had reviewed and accepted the identified exceptions to the GALL Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component under review. The staff audited these line items to verify consistency with the GALL Report and determined whether the AMR line item of the different component applied to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and confirmed whether the AMR line item of the different component was applicable to the component under review. The staff confirmed whether it had reviewed and accepted the exceptions to the GALL Report AMPs. It also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff audited these line items to verify consistency with the GALL Report, and determined whether the identified AMP would manage the aging effect consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

The staff audited and reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs. The staff's evaluation follows.

3.4.2.1.1 ARM Results Identified as Not Applicable

Based on its initial review, the staff could not determine the specific reason why the applicant considered LRA Table 3.4.1, line items 21, 23 to 27, 32, and 42 to be not applicable. In RAI-AMR-Generic-1, dated October 16, 2008, the staff requested that the applicant provide additional information regarding these not applicable line items so the staff could complete its evaluation.

In its response to the RAI dated November 12, 2008, the applicant stated that "Not Applicable" has been used when the component, material and environment combination does not exist in the identified GALL system grouping and also when the component, material and environment combination does exist but the LRA Table 3.x.1 item was not used because a different Table 3.x.1 item was selected to manage the identified aging effect/mechanism.

Based on its review, the staff finds the applicant's response to RAI-AMR-Generic-1 unacceptable because the applicant did not provide the specific reasons it used to consider the subject line items in LRA Table 3.1.1 not applicable and the staff could not complete its review.
In RAI-AMR-Generic-2, dated January 5, 2009, the staff requested that the applicant indicate for each of the LRA Table 3.x.1 items were "not applicable" is listed in the "discussion" column, the specific reason why the item is considered not applicable to TMI-1. The staff also requested that if the component, material and environment does exist but the LRA Table 3.x.1 item was not used, that the applicant indicate what other 3.x.1 item was selected to manage the identified aging effect/mechanism.

In its response to the RAI dated January 12, 2009, the applicant provided a table identifying the specific reason(s) why a Table 3.x.1 item is not considered applicable to TMI-1.
Based on its review, the staff finds the applicant's response to RAI AMR-Generic-2 acceptable because the applicant provided the basis for LRA Table 3.x.1 line items identified as "not applicable." The staff's concern described in RAI AMR-Generic-2 is resolved.

LRA Table 3.4.1, Item 21 addresses high strength steel closure bolting exposed to air with steam or water leakage. The GALL Report recommends the Bolting Integrity AMP to manage cracking due to cyclic loading, stress corrosion cracking in this component group. In the applicant's response to RAI-AMR-Generic-2, the applicant stated that this line item is not applicable because there is no high-strength steel closure bolting exposed to air with steam or water leakage in steam and power conversion systems. The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that TMI-1 does not have support systems that are part of the steam and power conversion systems with-in the scope of license renewal that contain the high strength closure bolting fabricated from steel exposed to air with steam or water leakage. Based on its review of the LRA, the staff confirmed that there is no high-strength steel closure bolting exposed to air with steam or water leakage in steam and power conversion systems, and therefore, finds the applicant's determination acceptable.

LRA Table 3.4.1, Item 23 addresses stainless steel piping, piping components, and piping elements exposed to closed cycle cooling water greater than 60° C (greater than 140°F). The GALL Report recommends the Closed Cycle Cooling Water System AMP to manage cracking due to stress corrosion cracking in this component group. In the applicant's response to RAI-AMR-Generic-2, the applicant stated that this line item is not applicable because there are no stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water greater than 60° C (greater than 140°F) in steam and power conversion systems. The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that TMI-1 does not have support systems that are part of the steam and power conversion systems with-in the scope of license renewal that contain the piping, piping components and piping elements fabricated from stainless steel exposed to closed cycle cooling water greater than 60° C (greater than 140°F). Based on its review of the LRA, the staff confirmed that there are no stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water greater than 60° C (greater than 140°F) in steam and power conversion systems, and therefore, finds the applicant's determination acceptable.

LRA Table 3.4.1, Item 24 addresses steel heat exchanger components exposed to closed cycle cooling water. The GALL Report recommends the Closed Cycle Cooling Water System AMP to manage loss of material due to general, pitting, crevice, and galvanic corrosion. In the applicant's response to RAI-AMR-Generic-2, the applicant stated that this line item is not applicable because steel steam and power conversion systems heat exchanger components exposed to closed cycle cooling water have been included in the auxiliary systems closed cycle cooling water system and references LRA Section 2.1.6.1. The applicant also stated that this component, material, environment, and aging effect combination is addressed by item 3.3.1-47 from the auxiliary systems grouping since galvanic corrosion as identified in item 3.4.1-24 does not apply to these heat exchanger components. Based on its review of the LRA, the staff confirmed that steel steam and power conversion systems heat exchanger components exposed to closed cycle cooling water have been included in the auxiliary systems closed cycle cooling water system. The staff also confirmed that this component, material, environment, and aging effect combination is addressed by item 3.3.1-47 from the auxiliary systems grouping since galvanic corrosion as identified in item 3.4.1-24 does not apply to these heat exchanger components. The staff finds the applicant's determination acceptable.

LRA Table 3.4.1, Item 25 addresses stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water. The GALL Report recommends the Closed Cycle Cooling Water System AMP to manage loss of material due to pitting and crevice corrosion in this component group. In the applicant's response to RAI-AMR-Generic-2, the applicant stated that this line item is not applicable because there is no stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water in steam and power conversion systems. The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that TMI-1 does not have support systems that are part of the steam and power conversion systems with-in the scope of license renewal that contain the piping, piping components, piping elements and heat exchanger components fabricated from stainless steel exposed to closed cycle cooling water. Based on its review of the LRA, the staff confirmed that there are no stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water in steam and power conversion systems, and therefore, the staff finds the applicant's determination acceptable.

LRA Table 3.4.1, Item 26 addresses copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water. The GALL Report recommends the Closed Cycle Cooling Water System AMP to manage loss of material due to pitting, crevice, and galvanic corrosion in this component group. In the applicant's response to RAI-AMR-Generic-2, the applicant stated that this line item is not applicable because there is no copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water in steam and power conversion system. The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that TMI-1 does not have support systems that are part of the steam and power conversion systems with-in the scope of license renewal that contain the piping, piping components and piping elements fabricated from copper alloy exposed to closed cycle cooling water. Based on its review of the LRA, the staff confirmed that there is no copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water in steam and power conversion systems, and therefore, the staff finds the applicant's determination acceptable.

LRA Table 3.4.1, Item 27 addresses steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed cycle cooling water. The GALL Report recommends the Closed Cycle Cooling Water System AMP to manage reduction of heat transfer due to fouling in this component group. In the applicant's response to RAI-AMR-Generic-2, the applicant stated that this line item is not applicable because there is no steel, stainless steel, or copper alloy heat exchanger tubes exposed to closed cycle cooling water with an intended function of heat transfer in steam and power conversion systems. The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that TMI-1 does not have support systems that are part of the steam and power conversion systems with-in the scope of license renewal that contain the heat exchanger tubes fabricated from steel, stainless steel and copper alloy exposed to closed cycle cooling water. Based on its review of the LRA, the staff confirmed that there is no steel, stainless steel, or copper alloy heat exchanger tubes exposed to closed cycle cooling water with an intended function of heat transfer in steam and power conversion systems, and therefore, the staff finds the applicant's determination acceptable.

LRA Table 3.4.1, Item 32 addresses stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water. The GALL Report recommends the Open Cycle Cooling Water System AMP to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion in this component group. In the applicant's response to RAI-AMR-Generic-2, the applicant stated that this line item is not applicable because it predicts the additional aging effect/mechanism of loss of material/fouling for stainless steel in raw water. The applicant also stated that this component, material, environment, and aging effect/mechanism combination is addressed by item 3.4.1-33. Based on its review of the LRA, the staff confirmed that the applicant predicts the additional aging effect/mechanism of loss of material/fouling for stainless steel in raw water and also confirmed that this component, material, environment, and aging effect/mechanism combination is addressed by item 3.4.1-33. The staff finds the applicant's determination acceptable.

LRA Table 3.4.1, Item 42 addresses steel piping, piping components, and piping element exposed to air – indoor controlled (external). The GALL Report does not recommend an AMP as there is no aging effect/mechanism in this component group. In the LRA, the applicant stated that indoor air (controlled) environment is not used for steam and power conversion systems. The staff reviewed LRA Sections 2.3.4 and 3.4 and confirmed that TMI-1 does not have support systems that are part of the steam and power conversion systems with-in the scope of license renewal that contain the piping, piping components and piping elements fabricated from steel exposed to air – indoor controlled (external). Based on its review of the LRA, the staff confirmed that indoor air (controlled) environment is not used for steam and power conversion systems, and, therefore, the staff finds the applicant's determination acceptable.

3.4.2.1.2 Loss Of Material due to General, Pitting and Crevice Corrosion; Loss Of Preload Due to Thermal Effects, Gasket Creep, and Self-Loosening

LRA Table 3.4.1, Item 3.4.1-22 addresses loss of material due to general, pitting and crevice corrosion for steel components with its external surfaces exposed to outdoor air in the Condensate System.

The LRA credits the External Surfaces Monitoring Program to manage this aging effect for steel piping, fittings and valve body components in an outdoor air (external) environment only. The

GALL Report recommends GALL AMP XI.M18, "Bolting Integrity," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with the GALL Report material, environment, and aging effect, but a different aging management program is credited.

The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.16. The staff noted from its review that the AMR line items that the referenced Item 3.4.1-22 and credited the External Surfaces Monitoring Program are not bolting components with an intended function for mechanical closure. The staff further noted that the applicant referenced Item 3.4.1-22 of LRA Table 3.4.1 because there was not another applicable Table 1 line item in LRA Table 3.4.1 that corresponded to the same material, environment and aging effect combination.

The staff determined that the External Surfaces Monitoring Program, which includes periodic visual inspections of external surfaces performed during system walk downs, is adequate to manage loss of material due to general, pitting and crevice corrosion for steel components exposed to outdoor air (external) addressed by this AMR. On the basis of periodic visual inspections being performed during system walk downs of these components, the staff finds the applicant's use of the External Surfaces Monitoring program acceptable.

LRA Table 3.4.1, Item 3.4.1-22 addresses loss of material due to general, pitting and crevice corrosion for steel components with their external surfaces exposed to outdoor air or uncontrolled indoor air in the feed water system, the emergency feed water system and the main steam system. The staff noted that for those AMR line items in LRA Section 3.4 in which the applicant references Item 3.4.1-22, the applicant listed the environment as air with borated water leakage, which is a more aggressive environment, compared to outdoor air or uncontrolled indoor air. The staff confirmed in LRA Section 3.4 that for the same system, component, material and environment combination, the applicant manages loss of material due to boric acid corrosion with the Boric Acid Corrosion Program, as recommend by the GALL Report.

The LRA credits the External Surfaces Monitoring Program to manage this aging effect for steel piping, fittings and valve body components in an air with borated water leakage environment only. The GALL Report recommends GALL AMP XI.M18, "Bolting Integrity," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with the GALL Report material, environment, and aging effect, but a different aging management program is credited.

The staff reviewed the applicant's External Surfaces Monitoring program and its evaluation is documented in SER Section 3.0.3.2.16. The staff noted from its review that all AMR line items that the referenced Item 3.4.1-21 and credited the External Surfaces Monitoring Program are not bolting components with an intended function for mechanical closure. The staff determined that the External Surfaces Monitoring Program, which includes periodic visual inspections of external surfaces performed during system walk downs, is adequate to manage loss of material due to general, pitting and crevice corrosion for steel components exposed to air with borated water leakage environment addressed by this AMR. On the basis of periodic visual inspections being performed during system walk downs of these components by the External Surfaces Monitoring Program, and the applicant monitoring these components with the Boric Acid Corrosion Program, for loss of material due to boric acid corrosion, the staff finds the applicant's use of the External Surfaces Monitoring Program acceptable.

Based on a review of the programs identified, the staff determines that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.1.3 Loss of Material due to Pitting and Crevice Corrosion

LRA Table 3.5.1, Item 3.5.1-50 addresses loss of material due to pitting and crevice corrosion for stainless steel components with their external surfaces exposed to outdoor air in the condensate system. The staff noted that the applicant referenced Item 3.5.1-50 of LRA Table 3.5.1 because there was not an applicable Table 1 line item in LRA Table 3.4.1 that corresponded to the same material, environment and aging effect combination.

The LRA credits the External Surfaces Monitoring Program to manage this aging effect for stainless steel piping, fittings and valve body components in an outdoor air (external) environment only. The GALL Report recommends GALL AMP XI.S6, "Structures Monitoring Program," to manage this aging effect. The AMR line items that reference this line item in GALL Report Table 1 cite Generic Note E, indicating that the AMR line items are consistent with the GALL Report material, environment, and aging effect, but a different aging management program is credited. The staff confirmed that only components that align to GALL Item III.B2-7 and are fabricated from stainless steel materials, are applicable to TMI-1.

The staff reviewed the External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.16. The staff finds that the External Surfaces Monitoring Program, which include periodic visual inspections of external surfaces performed during system walkdowns, is adequate to manage loss of material due to pitting and crevice corrosion for stainless steel components exposed to outdoor air (external) addressed by this AMR. On the basis of periodic visual inspections being performed during system walkdowns of these components, the staff finds the applicant's use of the External Surfaces Monitoring program acceptable.

Based on a review of the programs identified, the staff determines that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation is Recommended

LRA Section 3.4.2.2 provides further evaluation of aging management, as recommended by the GALL Report for the steam and power conversion system components. The applicant provided information concerning how it will manage the following aging effects:

- Cumulative Fatigue Damage
- Loss of Material due to General, Pitting, and Crevice Corrosion
- Loss of Material due to General, Pitting, Crevice, MIC, and Fouling
- Reduction of Heat Transfer due to Fouling
- Loss of Material due to General, Pitting, Crevice, and MIC

- Cracking due to SCC
- Loss of Material due to Pitting and Crevice Corrosion
- Loss of Material due to Pitting, Crevice, and MIC
- Loss of Material due to General, Pitting, Crevice, and Galvanic Corrosion

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report and for which the GALL Report recommends further evaluation, the staff audited and reviewed the applicant's evaluations to determine whether they adequately address those issues and reviewed the applicant's further evaluations against the criteria in SRP-LR Section 3.4.2.2. The staff's review of the applicant's further evaluations follows.

3.4.2.2.1 Cumulative Fatigue Damage

LRA Section 3.4.2.2.1 states that fatigue is a TLAA, as defined in 10 CFR 54.3. An applicant must evaluate TLAAs in accordance with 10 CFR 54.21(c)(1). SER Section 4.3 documents the staff's review of the applicant's evaluation of this TLAA.

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

The staff reviewed LRA Section 3.4.2.2.2 against the criteria in SRP-LR Section 3.4.2.2.2.

(1) LRA Section 3.4.2.2.2.1 addresses loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water or steam in the auxiliary steam system, condensate system, condensers and air removal system, emergency feedwater system, extraction steam system, feedwater system, liquid and gas sampling system, main steam system, makeup and purification system (high pressure injection), miscellaneous floor and equipment drains system, steam turbine and auxiliary system, and water treatment and distribution system. The applicant stated that the aging effect of loss of material due to general, pitting and crevice corrosion in these components will be managed by a combination of the Water Chemistry Program and the One-Time Inspection Program. The applicant also stated that loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, piping elements, and tanks exposed to treated water in the closed-cycle cooling water system will be managed by the Closed-Cycle Cooling Water System Program.

    The staff reviewed LRA Section 3.4.2.2.2 against the criteria in SRP-LR Section 3.4.2.2.2, which states that loss of material due to general, pitting, and crevice corrosion may occur in steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water and for steel piping, piping components, and piping elements exposed to steam. The SRP-LR states that the existing AMP relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion, but that control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations with stagnant flow conditions; therefore, the effectiveness of water chemistry control programs should be confirmed to ensure that corrosion does not occur. The GALL Report recommends further evaluation of programs to verify the effectiveness of water chemistry control programs. The SRP-LR states that a one-time inspection of selected components and susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that the program, with an enhancement, is consistent with GALL AMP XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection program. The staff's evaluation of this program, which is documented in SER Section 3.0.3.2.14, determined that the One-Time Inspection Program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence or note the absence of loss of material in susceptible locations due to general, pitting, and crevice corrosion for components within the scope of the program. Based on the staff's determination that the applicant's Water Chemistry program provides mitigation and the applicant's One-Time Inspection Program provides detection for the potential aging effect of loss of material due to general, pitting, and crevice corrosion, the staff finds the applicant's proposed AMPs for managing the aging effect of loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water or steam in the auxiliary steam system, condensate system, condensers and air removal system, emergency feedwater system, extraction steam system, feedwater system, liquid and gas sampling system, main steam system, makeup and purification system (high pressure injection), miscellaneous floor and equipment drains system, steam turbine and auxiliary system, and water treatment and distribution system to be acceptable.

The staff noted that in LRA Table 3.3.2-4 (LRA pages 3.3-154 and -159) the applicant included two (2) AMR result lines referring to LRA Table 3.4.1, item 3.4.1-4, for carbon steel piping and fittings and for valve bodies exposed to treated water in the closed cycle cooling water system. For these components, the applicant stated that the aging effect of loss of material due to general, pitting, and crevice corrosion will be managed by the Closed-Cycle Cooling Water System Program and cited generic note E, indicating that the AMR result is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff reviewed the applicant's Closed-Cycle Cooling Water System Program and its evaluation is documented in SER Section 3.0.3.2.6. The staff finds that the Closed-Cycle Cooling Water System Program, when enhanced, is consistent with GALL AMP XI.M21, "Closed-Cycle Cooling Water." The staff found that the applicant's Closed-Cycle Cooling Water System Program includes preventive actions to minimize corrosion and periodic inspection activities to detect corrosion. Because the AMP includes both preventive actions and inspection activities, the staff finds that the applicant's use of the Closed-Cycle Cooling Water System Program for managing the aging effect of loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, piping elements and valves exposed to treated water in the closed cooling water system to be acceptable.

(2) LRA Section 3.4.2.2.2 addresses the loss of material due to general, pitting, and crevice corrosion in steel piping, piping components, and piping elements exposed to lubricating oil stating that line item number 3.4.1-7 is not applicable to TMI-1. The LRA also states that the lubricating oil environment in the steam and power conversion system includes the additional aging mechanism of MIC and that Table 1 item number 3.4.1-12 applies.

The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lube oil chemistry control program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring.

The staff compared SRP-LR Sections 3.4.2.2.2 and 3.4.2.2.5 and noted that both sections provide for management of loss of material due to general, pitting and crevice corrosion in steel components by controlling contaminants and a verification of effectiveness, in which the applicant will utilize its Lubricating Oil Analysis Program and verify the effectiveness of the Lubricating Oil Analysis Program with the One-Time Inspection Program. The staff noted that steel piping, piping components, and piping elements exposed to lubricating oil are part of the scope of LRA Section 3.4.2.2.5 and therefore general, pitting and crevice corrosion will be managed in accordance with GALL Report recommendations through the period of extended operation.

The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material and 2) will provide for one-time inspections of select steel components exposed to lubricating oil for loss of material due to general, pitting and crevice corrosion at susceptible locations to verify the effectiveness of the applicant's Lubricating Oil Analysis Program in applicable Steam and Power systems. Therefore, the staff finds that, based on a review of the programs identified above, the criteria of SRP-LR Section 3.4.2.2.2 is satisfied.

Based on the staff's review and evaluation of the applicant's programs, the staff concludes that the applicant's programs satisfy SRP-LR Section 3.4.2.2.2 criteria. For those line items that apply to LRA Section 3.4.2.2.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.3 Loss of Material due to General, Pitting, Crevice, and MIC, and Fouling

The staff reviewed LRA Section 3.4.2.2.3 against the criteria in SRP-LR Section 3.4.2.2.3.

LRA Section 3.4.2.2.3 addresses loss of material due to general, pitting, crevice, microbiologically-influenced corrosion and fouling in steel piping, piping components and piping elements exposed to raw water.

SRP-LR Section 3.4.2.2.3 states that loss of material due to general, pitting, crevice, microbiologically-influenced corrosion and fouling may occur in steel piping, piping components and piping elements exposed to raw water. The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will manage this aging effect in steel internal surfaces exposed to internal raw water.

The GALL Report, under Item VIII.G-36 recommends that a plant-specific program be credited to manage this aging effect for steel piping, piping components and piping elements in the Steam and Power Conversion Systems.

The staff confirmed that only piping, fittings and tanks that align to GALL AMR VIII.G-36 for the Reactor Building Sump and Drain System and the Radwaste System that are fabricated from steel materials are applicable to TMI that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The staff noted that these systems, in which the applicant has referenced Item VII.G-36, are not part of the Steam and Power Conversion Systems. The systems were grouped together with this GALL AMR item because the material, environment, and aging effect combination corresponded. The staff confirmed, as stated in the LRA, that there are no steel piping, piping components and piping elements exposed to raw water in the steam and power conversion systems.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are adequate to manage loss of material due to general, pitting, crevice, microbiologically-influenced corrosion and fouling in steel piping, piping components and piping elements exposed to raw water on the internal surface.

Based on the staff's review and evaluation of the applicant's program, the staff concludes that the applicant's program meets SRP-LR Section 3.4.2.2.3 criteria and, therefore, the applicant's AMRs are consistent with those under GALL Report Items VII.G-36. For those line items that apply to LRA Section 3.4.2.2.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.4 Reduction of Heat Transfer due to Fouling

The staff reviewed LRA Section 3.4.2.2.4 against the criteria in SRP-LR Section 3.4.2.2.4.

(1) LRA Section 3.4.2.2.4 addresses the applicant's aging management basis for managing reduction of heat transfer due to fouling in stainless steel heat exchanger components exposed to treated water in the condenser and air removal system. The applicant stated that the aging effect of reduction of heat transfer due to fouling in these components will be managed by a combination of the Water Chemistry Program and the One-Time Inspection Program.

    The staff reviewed LRA Section 3.4.2.2.4 against the criteria in SRP-LR Section 3.4.2.2.4, which states that reduction of heat transfer due to fouling may occur for stainless steel and copper alloy heat exchanger tubes exposed to treated water. The SRP-LR states that the existing aging management program relies on control of water chemistry to manage reduction of heat transfer due to fouling, but control of water chemistry may not always have been adequate to preclude fouling. The GALL Report recommends that the effectiveness of the water chemistry control program should be confirmed to ensure that reduction of heat transfer due to fouling is not occurring. The SRP-LR states that a one-time inspection is an acceptable method to ensure that reduction of heat transfer is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff reviewed the Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that the Water Chemistry Program, with an enhancement, is consistent with GALL AMP XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection Program and its evaluation is documented in SER Section 3.0.3.2.14. The staff finds that the One-Time Inspection Program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence or note the absence of heat exchanger tube fouling that might result in reduction of heat transfer for components within the scope of the program. Based on the staff's determination that the applicant's Water Chemistry Program provides mitigation and the applicant's One-Time Inspection Program provides detection for the potential aging effect of reduction in heat transfer due to heat exchanger tube fouling, the staff finds the applicant's proposed AMPs for managing the aging effect of reduction of heat transfer due to fouling in stainless steel heat exchanger components exposed to treated water in the condenser and air removal system to be acceptable.

(2) LRA Section 3.4.2.2.4 states that the One-Time Inspection Program will be implemented to verify the effectiveness of the Lubricating Oil Analysis Program, B.2.1.23, to manage the reduction of heat transfer due to fouling in steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil in the closed cycle cooling water system, emergency diesel generators and auxiliary systems, and station blackout and uninterruptable power supply (UPS) diesel generator systems.

The staff reviewed LRA Section 3.4.2.2.4 against the criteria in SRP-LR Section 3.4.2.2.4, which states that reduction of heat transfer due to fouling could occur for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil. Furthermore, the existing aging management program relies on monitoring and control of lube oil chemistry to mitigate reduction of heat transfer due to fouling. The GALL Report recommends further evaluation of programs to verify the effectiveness of lube oil chemistry control program. SRP-LR states a one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly.

The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of heat transfer due to fouling and 2) will provide for one-time inspections of select steel, stainless steel and copper alloy heat exchanger tubing exposed to lubricating oil for loss of heat transfer due to fouling at susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program in applicable steam and power conversion systems.

Based on the staff's review and evaluation of the applicant's programs, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.4 criteria. For those line items that apply to LRA Section 3.4.2.2.4, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.5 Loss of Material due to General, Pitting, Crevice, and MIC

The staff reviewed LRA Section 3.4.2.2.5 against the criteria in SRP-LR Section 3.4.2.2.5.

(1) LRA Section 3.4.2.2.5 states the Buried Piping and Tanks Inspection Program will be implemented to manage the loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion in steel piping, piping components, piping elements, and tanks exposed to soil in the condensate system and the emergency diesel generators and auxiliary system.

The staff reviewed LRA Section 3.4.2.2.5 against the criteria in SRP-LR Section 3.4.2.2.5, which states that loss of material due to general, pitting and crevice corrosion, and MIC could occur in steel (with or without coating or wrapping) piping, piping components, piping elements and tanks exposed to soil. Furthermore, the effectiveness of the buried piping and tanks inspection program should be confirmed to evaluate an applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

The staff reviewed the Buried Piping and Tanks Inspection Program and its evaluation is documented in SER Section 3.0.3.2.15. The staff finds that this program provides focused or opportunistic excavations and inspections for general, pitting, crevice, and microbiologically-influenced corrosion of buried steel piping and tanks within ten years before the period of extended operation and within ten years after the initiation of the period of operation except for the buried diesel generator fuel storage 30,000 gallon tank where ultrasonic testing of the tank walls will be performed from the inside of the tank to verify acceptable wall thickness. Therefore, the staff finds that, based on a review of the program identified above, the applicant has met the criteria of SRP-LR Section 3.4.2.2.5.

(2) LRA Section 3.4.2.2.5 states the One-Time Inspection Program will be implemented for susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program, to manage the loss of material due to general, pitting, crevice, and MIC in steel, piping, piping components, piping elements, tanks, and heat exchanger components exposed to lubricating oil in the closed cycle cooling water system, condensate system, condensers & air removal system, emergency diesel generators and auxiliary systems, emergency feedwater system, feedwater system, main generator and auxiliary systems, makeup and purification system (high pressure injection), reactor coolant system, station blackout and UPS diesel generator systems, and steam turbine and auxiliary systems.

The staff reviewed LRA Section 3.4.2.2.5 against the criteria in SRP-LR Section 3.4.2.2.5, which states that loss of material due to general, pitting and crevice corrosion, and MIC could occur in steel heat exchanger components exposed to lubricating oil. Furthermore the existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. SRP-LR Section 3.4.2.2.5 states the effectiveness of lubricating oil contaminant control can be achieved through a one-time inspection of selected components at susceptible locations.

The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and 2) will provide for one-time inspections of select steel heat exchanger tubing exposed to lubricating oil for loss of heat transfer due to fouling at susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program in applicable Steam and Power Conversion systems.

LRA Section 3.4.2.2.5 addresses loss of material due to general, pitting, crevice and microbiologically-influenced corrosion in steel heat exchanger components exposed to lubricating oil. The staff reviewed LRA Section 3.4.2.2.5 against the criteria in SRP-LR Section 3.4.2.2.5, which states that loss of material due to general, pitting, crevice and microbiologically-influenced corrosion may occur in steel heat exchanger components exposed to lubricating oil. The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will manage this aging effect in steel internal surfaces exposed to lubricating oil.

The GALL Report, under Item VIII.G-6 recommends that the Lubricating Oil Analysis Program be credited to manage this aging effect and that a plant-specific AMP be evaluated and credited to verify that the Lubricating Oil Analysis Program is achieving its mitigative function to manage loss of material due to general, pitting, crevice and microbiologically-influenced corrosion for steel heat exchanger components. These GALL Report AMRs identify a One-Time Inspection Program as an acceptable AMP to credit for the verification of the effectiveness of the Lubricating Oil Analysis Program.

The staff confirmed that only piping, fittings, tanks and valve bodies that align to GALL AMRs VIII.G-6 for the Radwaste System that are fabricated from steel materials are applicable to TMI-1 that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The staff noted that the radwaste system which the applicant has referenced in Item VIII.G-6 is not a part of the steam and power conversion systems, but was grouped together with this AMR GALL item because the material, environment, and aging effect combination corresponded.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are adequate to manage loss of material due to general, pitting, crevice and microbiologically-influenced corrosion in steel heat exchanger components exposed to lubricating oil.

Based on the staff's review and evaluation of the applicant's program, the staff concludes that the applicant's program meets SRP-LR Section 3.4.2.2.5 criteria. For those line items that apply to LRA Section 3.4.2.2.5, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.6 Cracking due to SCC

The staff reviewed LRA Section 3.4.2.2.6 against the criteria in SRP-LR Section 3.4.2.2.6.

LRA Section 3.4.2.2.6 addresses *cracking due to stress corrosion cracking*, *stating that line item* 3.4.1-13 is applicable to BWRs only and is not used for TMI-1, which is a PWR. This item pertains to SCC in stainless steel piping, piping components, and piping elements exposed to steam. TMI-1 is a PWR. The staff agrees that this line item is not applicable to TMI-1.

LRA Section 3.4.2.2.6 states that TMI-1 will implement a One-Time Inspection Program, for susceptible locations to verify the effectiveness of the Water Chemistry Program to manage *cracking due to stress corrosion cracking in stainless steel piping, piping components, piping* elements, and heat exchanger components exposed to treated water greater than 60° C (greater than 140° F) in the auxiliary steam system, closed cycle cooling water system, condensate system, extraction steam system, feedwater system, liquid and gas sampling system, main generator and auxiliary systems, main steam system, and steam turbine and auxiliary systems.

The staff reviewed LRA Section 3.4.2.2.6 against the criteria in SRP-LR Section 3.4.2.2.6 which states that SCC *may occur in stainless steel piping, piping components, piping elements, tanks,* and heat exchanger components exposed to treated water greater than 60 °C (140 °F). The SRP-LR also states that the existing aging management program relies on monitoring and control of water chemistry to manage the effects of cracking due to SCC, however, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause SCC. The GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure that SCC is not occurring and that a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that SCC is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff reviewed the AMR result line referencing LRA Table 3.4.1, item 3.4.1-14. The staff noted that the applicant proposed to manage the aging effect of cracking due to stress corrosion cracking using a combination of the Water Chemistry Program and the One-Time Inspection Program for this line item.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that the Water Chemistry Program, with an enhancement, is consistent with GALL AMR XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection Program and its evaluation is documented in SER Section 3.0.3.2.14. The staff finds that the One-Time Inspection Program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence of cracking due to stress corrosion cracking for components within its scope. Based on the staff's determination that the applicant's Water Chemistry Program provides mitigation and the applicant's One-Time Inspection Program provides detection for the potential aging effect of cracking due to stress corrosion cracking, the staff finds the applicant's proposed AMPs for managing the aging effect of cracking due to stress corrosion cracking in stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water greater than 60 °C (140 °F) acceptable.

Based on the staff's review and evaluation of the applicant's programs, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.6 criteria. For those line items that apply to LRA Section 3.4.2.2.6, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.7 Loss of Material due to Pitting and Crevice Corrosion

The staff reviewed LRA Section 3.4.2.2.7 against the criteria in SRP-LR Section 3.4.2.2.7.

(1) LRA Section 3.4.2.2.7 addresses the applicant's aging management basis for managing loss of material due to pitting and crevice corrosion in aluminum and copper alloy piping, piping components and piping elements exposed to treated water, and in stainless steel piping, piping components, and piping elements, tanks, and heat exchanger components exposed to treated water in the steam and power conversion system. The applicant stated that the aging effect of loss of material due to pitting and crevice corrosion will be managed by a combination of the Water Chemistry program and the One-Time Inspection Program. The applicant also stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will be used to manage the aging effect of loss of material due to pitting and crevice corrosion in stainless steel piping, piping components and piping elements exposed to treated water in the circulating water system.

The staff reviewed LRA Section 3.4.2.2.7 against the criteria in SRP-LR Section 3.4.2.2.7, which states that loss of material due to pitting and crevice corrosion may occur for stainless steel, aluminum, and copper alloy piping, piping components and piping elements and for stainless steel tanks and heat exchanger components exposed to treated water. SRP-LR Section 3.4.2.2.7 states that the existing aging management program relies on monitoring and control of water chemistry to manage the effects of loss of material due to pitting, and crevice corrosion; however, control of water chemistry does not preclude corrosion at locations of stagnant flow conditions. The GALL Report recommends that the effectiveness of the water chemistry program should be confirmed to ensure that corrosion is not occurring. SRP-LR Section 3.4.2.2.7 states that a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and the component's intended function will be maintained during the period of extended operation.

The staff reviewed the AMR results lines referencing to LRA Table 3.4.1, items 3.4.1-15 and 3.4.1-16. The staff noted that the applicant proposed to manage the aging effect of loss of material due to pitting and crevice corrosion using a combination of the Water Chemistry Program and the One-Time Inspection Program for all components referencing items 3.4.1-15 and 3.4.1-16 except for stainless steel valve bodies in the circulating water system. For stainless steel valve bodies in the circulating water system the staff noted that the applicant proposed to manage the aging effect of loss of material due to pitting and crevice corrosion using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that the Water Chemistry Program, with an enhancement, is consistent with GALL AMR XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection Program and its evaluation is documented in SER Section 3.0.3.2.14. The staff finds that the One-Time Inspection Program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence or note the absence of loss of material due to pitting and crevice corrosion in susceptible locations for components within its scope. Based on the staff's determination that the applicant's Water Chemistry Program provides mitigation and the applicant's One-Time Inspection Program provides detection for the potential aging effect of loss of material due to pitting and crevice corrosion, the staff finds the applicant's proposed AMPs for managing the aging effect of loss of material due to pitting and crevice corrosion in aluminum alloy, copper alloy, and stainless steel piping, piping components, piping elements, tanks, and heat exchangers components exposed to treated water in the steam and power conversion system acceptable.

The staff reviewed the applicant's Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the applicant's AMP is consistent with GALL AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," with an acceptable exception. The staff's evaluation determined that the applicant's AMP provides for internal inspection of components during periodic system and component surveillances or during routine maintenance activities, that the inspections are adequate to detect the presence or note the absence of loss of material due to pitting and crevice corrosion for components within its scope, and that if degraded conditions are found the program requires evaluation and corrective actions in accordance with the applicant's quality assurance program. On the basis that the applicant's Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program is capable of detecting the aging effect of loss of material due to pitting and crevice corrosion and requires corrective actions if degraded conditions are found, the staff finds the applicant's proposed AMP for managing loss of material due to pitting and crevice corrosion in stainless valve bodies exposed to treated water in the circulating water system acceptable.

LRA Section 3.4.2.2.7 addresses loss of material due to pitting and crevice corrosion in stainless steel piping, piping components, piping elements, tanks and heat exchanger components exposed to treated water. The staff reviewed LRA Section 3.4.2.2.7 against the criteria in SRP-LR Section 3.4.2.2.7, which states that loss of material due to pitting and crevice corrosion may occur in stainless steel piping, piping components, piping elements, tanks and heat exchanger components exposed to treated water. The applicant stated that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will manage this aging effect in stainless steel components exposed to treated water.

The GALL report, under Items VIII.E-4, VIII.E-36, VIII.F-27, VIII.B1-4, VIII.C-1, VIII.D1-4, VIII.D2-4, VIII.E-29, VIII.F-23 and VIII.G-32 and SRP-LR Section 3.4.2.2.7 Item No. 1 recommends that Water Chemistry Program be credited to manage this aging effect and that a plant-specific AMP be evaluated and credited to verify that the Water Chemistry Program is achieving its mitigative function to manage loss of material due to pitting and crevice corrosion for stainless steel piping and piping components and elements. These GALL AMRs identify a one-time inspection program is an acceptable AMP to credit for the verification of the effectiveness of the Water Chemistry Program.

The staff confirmed that only valve bodies that align to GALL AMRs VIII.B1-4 for the Circulating Water System that are fabricated from stainless steel materials are applicable to TMI that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program performs visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that are adequate to manage loss of material due to pitting and crevice corrosion in stainless steel piping, piping components, piping elements, tanks and heat exchanger components exposed to treated water.

(2) LRA Section 3.4.2.2.7 states that a Buried Piping and Tanks Inspection program, will be implemented to manage the loss of material due to pitting and crevice corrosion in stainless steel piping, piping components, and piping elements exposed to soil in the condensate system. The applicant's Buried Piping and Tanks Inspection Program includes preventive measures to mitigate corrosion such as the use of external coatings and wrappings, and it includes periodic inspection of external surfaces for loss of material to manage the effects of corrosion on the pressure-retaining capacity of piping and components in a soil (external) environment, which are in accordance with standard industry practices.

The staff reviewed LRA Section 3.4.2.2.7 against the criteria in SRP-LR Section 3.4.2.2.7, which states that states that loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements exposed to soil. The GALL Report recommends further evaluation of a plant specific aging management program to ensure that this aging effect is adequately managed and acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

In the discussion column of LRA Table 3.4.2-1, the applicant stated that loss of material of stainless steel piping exposed to the buried (external) environment is managed with Buried Piping and Tank Inspection Program. The staff noted that for the AMR results line that references LRA Table 3.4.2-1, the applicant included a reference to Note E. The staff reviewed the AMR results line referenced to Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends a plant specific program, the applicant has proposed using the Buried Piping and Tank Inspection Program.

The staff reviewed the Buried Piping and Tanks Inspection Program and its evaluation is documented in SER Section 3.0.3.2.15. The staff finds that this program will provide planned inspections within ten years from entering the period of extended operation unless an opportunistic inspection has occurred within this ten-year period for stainless steel components exposed to soil for loss of material due to pitting and crevice corrosion in condensate system (the gland steam condenser is evaluated with the condensate system). The Buried Piping and Tanks Inspection Program is in accordance with the recommendations of GALL AMP XI.M34 "Buried Piping and Tanks Inspection." The staff noted that although GALL AMP XI.M34 cites applicability to only steel and gray cast iron components, stainless steel components in the scope of this program will also be adequately managed for loss of material because excavation of stainless steel components and subsequent visual inspection will detect any loss of material due to pitting and crevice corrosion.

(3) LRA Section 3.4.2.2.7 states that a One-Time Inspection Program, will be implemented for susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program, to manage the loss of material due to pitting and crevice corrosion in copper alloy piping, piping components, and piping elements exposed to lubricating oil in the condensers & air

removal system, emergency feedwater system, feedwater system, and main generator and auxiliary systems.

The staff reviewed LRA Section 3.4.2.2.7 against the criteria in SRP-LR Section 3.4.2.2.7, which states that loss of material due to pitting and crevice corrosion could occur for copper alloy piping, piping components, and piping elements exposed to lubricating oil. Furthermore, the existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. SRP-LR Section 3.4.2.2.7 states the effectiveness of lubricating oil contaminant control can be confirmed through a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring.

The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Section 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting and corrosion and 2) will provide for one-time inspections of select copper alloy piping, piping components, and piping elements exposed to lubricating oil for loss of material due to pitting and crevice corrosion at susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program in applicable Steam and Power Conversion systems.

Based on the staff's review and evaluation of the applicant's programs, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.7 criteria. For those line items that apply to LRA Section 3.4.2.2.7, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.8 Loss of Material due to Pitting, Crevice, and MIC

The staff reviewed LRA Section 3.4.2.2.8 against the criteria in SRP-LR Section 3.4.2.2.8.

LRA Section 3.4.2.2.8 addresses loss of material due to pitting, crevice and microbiologically-influenced corrosion in stainless steel piping, piping components, piping elements and heat exchanger components exposed to lubricating oil.

SRP-LR Section 3.4.2.2.8 which states that loss of material due to pitting, crevice and microbiologically-influenced corrosion, may occur in stainless steel piping, piping components, piping elements and heat exchanger components exposed to lubricating oil.

The GALL report, under Items VIII.G-3, VIII.A-9, VIII.D1-3, VIII.D2-3, VIII.E-26 and VIII.G-29 recommends that Lubricating Oil Analysis Program be credited to manage this aging effect and that a plant-specific AMP be evaluated and credited to verify that the Lubricating Oil Analysis Program is achieving its mitigative function to manage loss of material due to pitting, crevice and microbiologically-influenced corrosion for stainless steel piping and piping components and elements and heat exchanger components. These GALL AMRs identify a One-Time Inspection Program as an acceptable AMP to credit for the verification of the effectiveness of the Lubricating Oil Analysis Program.

The staff confirmed that only piping and fittings that align to GALL AMRs VIII.E-26 for the Instrument and Control Air System that are fabricated from stainless steel materials are applicable to TMI that credit the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program requires visual inspections of internal surfaces of components during periodic system and component surveillance activities or during maintenance activities when the internal surface becomes accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. The staff finds that this program includes activities that is adequate to manage loss of material due to pitting, crevice and microbiologically-influenced corrosion in stainless steel piping, piping components, piping elements and heat exchanger components exposed to lubricating oil.

LRA Section 3.4.2.2.8 states that a One-Time Inspection program, B.2.1.18, will be implemented for susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program, to manage the loss of material due to pitting, crevice, and microbiologically-influenced corrosion in stainless steel piping, piping components, piping elements, and tanks exposed to lubricating oil in the condensers & air removal system, emergency feedwater system, feedwater system, and steam turbine and auxiliary systems.

The staff reviewed LRA Section 3.4.2.2.8 against the criteria in SRP-LR Section 3.4.2.2.8, which states that loss of material due to pitting, crevice, and MIC could occur in stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil. Furthermore, the existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. SRP-LR Section 3.4.2.2.8 states the effectiveness of lubricating oil contaminant control can be confirmed through a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring.

The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting, crevice and microbiologically-influenced corrosion and 2) will provide for one-time inspections of select stainless steel piping, piping components, piping elements exposed to lubricating oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion at susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program in applicable Steam and Power Conversion systems.

Based on the staff's review and evaluation of the applicant's programs, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.8 criteria. For those line items that apply to LRA Section 3.4.2.2.8, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.9 Loss of Material due to General, Pitting, Crevice, and Galvanic Corrosion

The staff reviewed LRA Section 3.4.2.2.9 against the criteria in SRP-LR Section 3.4.2.2.9.

LRA Section 3.4.2.2.9 addresses the applicant's aging management basis for managing loss of material due to general, pitting, crevice, and galvanic corrosion in steel heat exchanger components exposed to treated water in the condensers and air removal system. The applicant stated that the aging effect of loss of material due to general, pitting, crevice and galvanic corrosion in these components will be managed by a combination of the Water Chemistry Program and the One-Time Inspection Program. The applicant also stated that the aging effect of loss of material due to general, pitting and crevice corrosion in steel heat exchanger components in the feedwater system will be managed by a combination of the Water Chemistry Program and the One-Time Inspection Program; however, the applicant stated that the aging mechanism of galvanic corrosion does not apply to the feedwater system high pressure heaters since pressure boundary and leakage boundary components are not in contact with materials higher in galvanic series.

SRP-LR Section 3.4.2.2.9 states that loss of material due to general, pitting, crevice, and galvanic corrosion may occur in steel heat exchanger components exposed to treated water. SRP-LR Section 3.4.2.2.9 states that the existing AMP relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion, but control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations with stagnant flow conditions; therefore, the effectiveness of water chemistry control programs should be confirmed to ensure that corrosion does not occur. The GALL Report recommends that the effectiveness of water chemistry should be confirmed to confirm that corrosion does not occur. SRP-LR Section 3.4.2.2.9 states that a one-time inspection of selected components and susceptible locations is an acceptable method to ensure that corrosion does not occur and that component intended functions will be maintained during the period of extended operation.

In evaluating the applicant's proposed AMPs, the staff noted that in LRA Table 3.4.1, Item 3.4.1-5, the applicant stated that the result is not consistent with the GALL Report. The staff also noted that for AMR results in LRA Table 3.4.2-5 that refers to Item 3.4.1-5, the applicant cited Generic Note I, indicating that the aging effect in the GALL Report is not applicable for the component, material and environment combination in the applicant's AMR result. The staff noted that the applicant had determined the aging mechanism of galvanic corrosion not to be applicable for the in-scope (pressure and leakage boundary) components in the feedwater system high pressure heaters.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that the Water Chemistry Program, with an enhancement, is consistent with GALL AMP XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection Program and its evaluation is documented in SER Section 3.0.3.2.14. The staff finds that the applicant's One-Time Inspection Program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence or note the absence of loss of material due to general, pitting, crevice, and galvanic corrosion in susceptible locations for components within the scope of the program. Based on the staff's determination that the applicant's Water Chemistry Program provides mitigation and the applicant's One-Time Inspection Program provides detection for the potential aging effect of loss of material due to general, pitting, crevice, and galvanic corrosion, the staff finds the applicant's proposed AMPs for managing the aging effect of loss of material due to general, pitting, crevice, and galvanic corrosion in steel heat exchanger components exposed to treated water in the condensers and air removal system to be acceptable. The staff finds the applicant's proposed AMPs for managing the aging effect of loss of material due to general, pitting, and crevice corrosion in steel heat exchanger components in the feedwater system to be acceptable.

Based on the staff's review and evaluation of the applicant's programs, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.9 criteria. For those lines that apply to LRA Section 3.4.2.2.9, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.10 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA program.

3.4.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.4.2-1 through 3.4.2-8, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.4.2-1 through 3.4.2-8, the applicant indicated, via Notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. Specifically, Note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant had demonstrated that the aging effects will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.4.2.3.1 Steam and Power Conversion System – Condensate System – Summary of Aging Management Evaluation – LRA Table 3.4.2-1

The staff reviewed LRA Table 3.4.2-1, which summarizes the results of AMRs for the condensate system component groups.

In LRA Table 3.4.2-1, the applicant proposed to manage cracking due to stress corrosion cracking (SCC) for piping and fittings and valve bodies made of copper alloy with 15% or greater zinc exposed to an environment of treated water (internal) using the Water Chemistry Program and the One-Time Inspection Program. For these components the applicant cited generic note H, indicating that the aging effect is not in the GALL Report for this component, material and environment combination. The applicant also cited a plant-specific note stating that the aging effects/mechanisms for copper alloy with 15% or greater zinc in a treated water environment with ammonia present include cracking due to SCC.

The staff confirmed that the GALL Report does not list cracking due to SCC as an aging effect applicable for copper alloy with 15% or greater zinc exposed to treated water. The staff also reviewed selected portions of EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4, dated January 2006. The staff noted that Section 3.2.2, Appendix A of the EPRI report states that in the presence of ammonia or other ammonium compounds that may be in used in treated water systems, cracking due to SCC can occur in copper alloys containing 15% or greater zinc. On the basis that the aging effect is identified in the EPRI report, the staff finds the applicant's identification of cracking due to SCC in copper components exposed to treated water acceptable.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that Water Chemistry Program, with an enhancement, is consistent with GALL AMP XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection Program and its evaluation is documented in SER Section 3.0.3.2.14. The staff finds that the applicant's One-Time Inspection Program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence or note the absence of cracking due to SCC for components within the scope of the program. Based on the staff's determination that the Water Chemistry Program provides mitigation and the One-Time Inspection Program provides detection for the potential aging effect of cracking due to SCC, the staff finds the applicant's proposed AMPs for managing the aging effect of cracking due to SCC in piping and fittings and in valve bodies made of copper alloy with 15% or greater zinc exposed to an environment of treated water in the condensate system acceptable.

In LRA Table 3.4.2-1, the applicant designated Generic Note H for stainless steel piping and fittings exposed to a soil (external) environment in the condensate system because the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. The staff reviewed the GALL Report and found that the AMR line item, piping and fittings were not evaluated for a soil (external) environment for loss of material due to microbiologically influence corrosion. The applicant credits the Buried Piping and Tanks Inspection Program for managing loss of material due to microbiologically-influenced corrosion. The staff reviewed the Buried Piping and Tanks Inspection Program and its evaluation is documented in SER Section 3.0.3.2.15. The applicant's program provides for opportunistic and focused excavations of stainless steel piping and fittings during the last ten years of the current license period and within ten years after the commencement of the period of extended operation. The applicant's program also provides for inspection of the exposed piping and fittings that will determine if microbiologically-influenced corrosion is causing loss of material. Unacceptable degradation will be corrected through the applicant's Corrective Action Program. The staff determines that loss of material due to microbiologically-influenced corrosion of stainless steel piping and fittings exposed to soil will be adequately managed through the period of extended operation because piping will be subject to inspection that will detect loss of material such that any unacceptable degradation will be corrected.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.2 Steam and Power Conversion System – Condensers and Air Removal System – Summary of Aging Management Evaluation – LRA Table 3.4.2-2

The staff reviewed LRA Table 3.4.2-2, which summarizes the results of AMR evaluations for the condensers & air removal system component groups.

The applicant designated Note G for aluminum alloy filter housings and Note H for copper alloy (Zn less than 15%) piping and fittings exposed to a lubricating oil environment in the condensers & air removal system because the loss of material due to the mechanism of microbiologically-influenced corrosion for the AMR line item component, material, and environment combination is not evaluated in the GALL Report for the copper piping and fittings and the environment is not in the GALL Report for the aluminum alloy filter housings. The staff reviewed the GALL Report and found that the AMR line item, piping and fittings is not evaluated for a lubricating oil environment for loss of material due to microbiologically-influenced corrosion and accordingly Note H is appropriate and that the GALL Report does not address aluminum filter housings exposed to lubricating oil and accordingly Note G is appropriate. The applicant credits the Lubricating Oil Analysis Program and the One-time Inspection Program for managing loss of material due to pitting, crevice, and MIC. The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting, crevice and microbiologically-influenced corrosion and 2) will provide for one-time inspections of select components exposed to lubricating oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion at susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program. The staff noted that one-time inspection is an acceptable method to determine whether or not loss of material is occurring slowly such that the intended function will be maintained during the period of extended operation. On this basis, the staff finds that the Lubricating Oil Analysis Program and the One-Time Inspection Program are adequate to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion for these aluminum and copper alloy components exposed to lubricating oil through the period of extended operation.

In LRA Table 3.4.2-2, the applicant stated that for glass flow device and sight glasses in air-gas wetted internal environment there are no aging effects requiring management. The applicant referenced footnote "G" for this line item indicating that environment is not listed in the GALL Report for this material and component combination.

As indicated in "Corrosion Handbook" by H.H.Uhlig, the staff noted that glass as a material is impervious to normal plant environments. This conclusion is based on industry experience where the staff noted that no failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at temperatures or during time periods of concern for extended operation. The staff acknowledges that the use of glass in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation, since air-gas wetted internal environment does not contain hydroflouric acid or caustics. Based on this review and on the industry operating experience, the staff finds that glass in an air-gas wetted internal environment will not have any aging effects requiring aging management.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL

Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.3 Steam and Power Conversion System – Emergency Feedwater System – Summary of Aging Management Evaluation – LRA Table 3.4.2-3

The staff reviewed LRA Table 3.4.2-3, which summarizes the results of AMRs for the emergency feedwater system component groups.

In LRA Table 3.4.2-3, the applicant proposed to manage cracking due to stress corrosion cracking (SCC) for valve bodies and flow devices made of copper alloy with 15% or greater zinc exposed to an environment of treated water (internal) using the Water Chemistry Program and the One-Time Inspection Program. For these components the applicant cited generic note H, indicating that the aging effect is not in the GALL Report for this component, material and environment combination. The applicant also cited a plant-specific note stating that the aging effects/mechanisms for copper alloy with 15% or greater zinc in a treated water environment include cracking due to SCC.

The staff confirmed that the GALL Report does not list cracking due to SCC as an aging effect applicable for copper alloy with 15% or greater zinc exposed to treated water. The staff also reviewed selected portions of EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4, dated January 2006. The staff noted that Section 3.2.2, Appendix A of the EPRI report states that in the presence of ammonia or other ammonium compounds that may be in used in treated water systems, cracking due to SCC can occur in copper alloys containing 15% or greater zinc. On the basis that the aging effect is identified in the EPRI report, the staff finds the applicant's identification of cracking due to SCC in copper components exposed to treated water to be acceptable.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that the Water Chemistry Program, with an enhancement, is consistent with GALL AMP XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection Program and its evaluation is documented in SER Section 3.0.3.2.14. The staff finds that the One-Time Inspection Program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence or note the absence of cracking due to SCC for components within the scope of the program. Based on the staff's determination that the Water Chemistry Program provides mitigation and the One-Time Inspection Program provides detection for the potential aging effect of cracking due to SCC, the staff finds the applicant's proposed AMPs for managing the aging effect of cracking due to SCC in valve bodies and flow devices made of copper alloy with 15% or greater zinc exposed to an environment of treated water in the emergency feedwater system acceptable.

The staff noted that for nickel alloy piping and fittings, exposed to an air with borated water leakage (external) environment, the applicant assigned no aging effect and therefore no aging management program was assigned for these component/material/environment combinations. The staff noted that austenitic materials such as nickel alloys are not subject to loss of material or cracking when subjected to this environment and these materials are used as corrosion resistant replacement materials where other materials have degraded. According to EPRI NP-5769, "Degradation and Failure of Bolting in Nuclear Power Plants," Volumes 1 and 2, April 1988, corrosion resistant materials such as austenitic and martensitic stainless steels and high strength nickel base alloys offer good protection against boric acid corrosion. Therefore no aging management program is necessary for nickel alloys in the air with borated water leakage (external) environment.

In LRA Table 3.4.2-3, the applicant designated Note G for aluminum alloy sight glass housings and Note H for copper alloy (Zn less than 15%) piping fittings and copper alloy (Zn greater than 15%) sight glass housings exposed to a lubricating oil environment in the emergency feedwater system because the loss of material due to microbiologically-influenced corrosion for the AMR line item component, material, and environment combination is not evaluated in the GALL Report for the copper piping, fittings and sight glass housings and the environment is not in the GALL Report for the aluminum alloy sight glass Housings. The staff reviewed the GALL Report and found that the AMR line item, copper alloy piping, fittings, and sight glass housings is not evaluated for a lubricating oil environment for loss of material due to microbiologically-influenced corrosion and that the GALL Report does not address aluminum sight glass housings exposed to lubricating oil. The applicant credits the Lubricating Oil Analysis Program and the One-time Inspection Program for managing loss of material due to pitting, crevice, and MIC. The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting, crevice and microbiologically-influenced corrosion and 2) will provide for one-time inspections of select components exposed to lubricating oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion at susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program. The staff noted that one-time inspection is an acceptable method to determine whether or not loss of material is occurring slowly such that the intended function will be maintained during the period of extended operation. On this basis, the staff finds that the Lubricating Oil Analysis Program and the One-Time Inspection Program are adequate to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion for these aluminum and copper alloy components exposed to lubricating oil through the period of extended operation.

In LRA Table 3.4.2-3, the applicant stated that for steel piping and fittings, and valve bodies in treated water environment in the emergency feedwater system, wall thinning due to flow-accelerated corrosion is not an aging effect requiring management. The applicant referenced footnote "I, 2" stating that this system is a single phase system with a temperature below 200 °F and additionally, the system operates less than 2% of plant operating time.

The staff reviewed EPRI guidelines in NSAC-202L-R2 that are referenced in the GALL AMP XI.M17, "Flow-Accelerated Corrosion." This document provides guidelines for maintaining integrity of steel piping and valves containing high-energy fluids. The document considers temperature and operating time as criteria for susceptibility review and the temperature below 200 ° F, and operation less than 2% of plant operating time is under the limits for non-susceptibility for single-phase systems. On the basis that the emergency feedwater system is in normal stand-by and operates for less than 2% of the plant operating time, and the temperature is less than 200 °F, the staff finds that this system is not a high-energy fluid system, and therefore, wall thinning due to flow-accelerated corrosion is not an aging effect requiring management.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.4 Steam and Power Conversion System – Extraction Steam System – Summary of Aging Management Evaluation – LRA Table 3.4.2-4

The staff reviewed LRA Table 3.4.2-4, which summarizes the results of AMRs for the extraction steam system component groups.

In LRA Table 3.4.2-4, the applicant proposed to manage cracking due to stress corrosion cracking (SCC) for piping and fittings and valve bodies made of copper alloy with 15% or greater zinc exposed to an environment of treated water (internal) using the Water Chemistry Program and the One-Time Inspection Program. For these components, the applicant cited generic note H, indicating that the aging effect is not in the GALL Report for this component, material and environment combination. The applicant also cited a plant-specific note stating that the aging effects/mechanisms for copper alloy with 15% or greater zinc in a treated water environment include cracking due to SCC.

The staff confirmed that the GALL Report does not list cracking due to SCC as an aging effect applicable for copper alloy with 15% or greater zinc exposed to treated water. The staff also reviewed selected portions of EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4, dated January 2006. The staff noted that Section 3.2.2, Appendix A of the EPRI report states that in the presence of ammonia or other ammonium compounds that may be in used in treated water systems, cracking due to SCC can occur in copper alloys containing 15% or greater zinc. On the basis that the aging effect is identified in the EPRI report, the staff finds the applicant's identification of cracking due to SCC in copper components exposed to treated water to be acceptable.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that the program, with an enhancement, is consistent with GALL AMP XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection Program and its evaluation is documented in SER Section 3.0.3.2.14. The staff finds that the program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence or note the absence of cracking due to SCC for components within the scope of the program. Based on the staff's determination that the Water Chemistry Program provides mitigation and the One-Time Inspection Program provides detection for the potential aging effect of cracking due to SCC, the staff finds the applicant's proposed AMPs for managing the aging effect of cracking due to SCC in piping and fittings and valve bodies made of copper alloy with 15% or greater zinc exposed to an environment of treated water in the extraction steam system to be acceptable.

In LRA Table 3.4.2-4, the applicant proposed to manage cracking due to stress corrosion cracking (SCC) for valve bodies and flow devices made of copper alloy with 15% or greater zinc exposed to an environment of treated water (internal) using the Water Chemistry Program and the One-Time Inspection Program. For these components the applicant cited generic note H, indicating that the aging effect is not in the GALL Report for this component, material and environment combination. The applicant also cited a plant-specific note stating that the aging effects/mechanisms for copper alloy with 15% or greater zinc in a treated water environment include cracking due to SCC.

The staff confirmed that the GALL Report does not list cracking due to SCC as an aging effect applicable for copper alloy with 15% or greater zinc exposed to treated water. The staff also reviewed selected portions of EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4, dated January 2006. The staff noted that

Section 3.2.2, Appendix A of the EPRI report states that in the presence of ammonia or other ammonium compounds that may be in used in treated water systems, cracking due to SCC can occur in copper alloys containing 15% or greater zinc. On the basis that the aging effect is identified in the EPRI report, the staff finds the applicant's identification of cracking due to SCC in copper components exposed to treated water to be acceptable.

In LRA Table 3.4.2-4, the applicant stated that for glass sight glasses in air–gas wetted internal environment there are no aging effects requiring management. The applicant referenced footnote "G" for this line item indicating that environment is not listed in the GALL Report for this material and component combination.

As indicated in "Corrosion Handbook" by H.H.Uhlig, the staff noted that glass as a material is impervious to normal plant environments. This conclusion is based on industry experience where the staff noted that no failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at temperatures or during time periods of concern for extended operation. The staff acknowledges that the use of glass in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation, since air-gas wetted internal environment does not contain hydroflouric acid or caustics. Based on this review and on the industry operating experience, the staff finds that glass in an air-gas wetted internal environment will not have any aging effects requiring aging management.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.5 Steam and Power Conversion System – Feedwater System – Summary of Aging Management Evaluation – LRA Table 3.4.2-5

The staff reviewed LRA Table 3.4.2-5, which summarizes the results of AMRs for the feedwater system component groups.

In LRA Table 3.4.2-5, the applicant proposed to manage cracking due to stress corrosion cracking (SCC) for valve bodies made of copper alloy with 15% or greater zinc exposed to an environment of treated water (internal) using the Water Chemistry Program and the One-Time Inspection Program. For these components the applicant cited generic note H, indicating that the aging effect is not in the GALL Report for this component, material and environment combination. The applicant also cited a plant-specific note stating that the aging effects/mechanisms for copper alloy with 15% or greater zinc in a treated water environment include cracking due to SCC.

The staff confirmed that the GALL Report does not list cracking due to SCC as an aging effect applicable for copper alloy with 15% or greater zinc exposed to treated water. The staff also reviewed selected portions of EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4, dated January 2006. The staff noted that Section 3.2.2, Appendix A of the EPRI report states that in the presence of ammonia or other ammonium compounds that may be in used in treated water systems, cracking due to SCC can occur in copper alloys containing 15% or greater zinc. On the basis that the aging effect is identified in the EPRI report, the staff finds the applicant's identification of cracking due to SCC in copper components exposed to treated water acceptable.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that the program, with an enhancement, is consistent with GALL AMP XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection Program and its evaluation is documented in SER Section 3.0.3.2.14. The staff finds that the program is consistent with GALL AMP XI.M32, "One-Time Inspection," and is adequate to detect the presence or note the absence of cracking due to SCC for components within the scope of the program. Based on the staff's determination that the Water Chemistry Program provides mitigation and the One-Time Inspection Program provides detection for the potential aging effect of cracking due to SCC, the staff finds the applicant's proposed AMPs for managing the aging effect of cracking due to SCC in valve bodies made of copper alloy with 15% or greater zinc exposed to an environment of treated water in the feedwater system to be acceptable.
The staff noted that for nickel alloy piping, fittings, thermowells, exposed to an air with borated water leakage (external) environment, the applicant assigned no aging effect and therefore no aging management program was assigned for these component/material/environment combinations.

The staff noted that austenitic materials such nickel alloys are not subject to loss of material or cracking when subjected to this environment and these materials are used as corrosion resistant replacement materials where other materials have degraded. According to EPRI 5769, "Degradation and Failure of Bolting in Nuclear Power Plants, Volumes 1 and 2," April 1988, corrosion resistant materials such as austenitic and martensitic stainless steels and high strength nickel base alloys offer good protection against boric acid corrosion. Therefore no aging management program is necessary for nickel alloys in the air with borated water leakage (external) environment.

The applicant designated Note H for copper alloy (Zn less than 15%) piping fittings exposed to a lubricating oil environment in the feedwater system because the loss of material due to microbiologically-influenced corrosion for the AMR line item component, material, and environment combination is not evaluated in the GALL Report for the copper piping and fittings. The staff reviewed the GALL Report and concluded that the AMR line item, copper alloy piping and fittings, is not evaluated for a lubricating oil environment for loss of material due to microbiologically-influenced corrosion . The applicant credits the Lubricating Oil Analysis Program and the One-time Inspection Program for managing loss of material due to pitting, crevice, and MIC. The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting, crevice and microbiologically-influenced corrosion and 2) will provide for one-time inspections of select components exposed to lubricating oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion at susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program. The staff noted that one-time inspection is an acceptable method to determine whether or not loss of material is occurring slowly such that the intended function will be maintained during the period of extended operation. The staff finds that the Lubricating Oil Analysis Program and the One-Time Inspection Program are adequate to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion for these copper alloy components exposed to lubricating oil through the period of extended operation.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be

adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.6 Steam and Power Conversion System – Main Generator and Auxiliary Systems – Summary of Aging Management Evaluation – LRA Table 3.4.2-6

The staff reviewed LRA Table 3.4.2-6, which summarizes the results of AMR evaluations for the main generator and auxiliary systems component groups.

In LRA Table 3.4.2-6, the applicant designated Note H for copper alloy (Zn less than 15%) piping, fittings and valves exposed to a lubricating oil environment in the main generator and auxiliary system because the loss of material due to microbiologically-influenced corrosion for the AMR line item component, material, and environment combination is not evaluated in the GALL Report for the copper piping, and fittings. The staff reviewed the GALL Report and concluded that the AMR line item, copper alloy piping, fittings, and valves is not evaluated for a lubricating oil environment for loss of material due to microbiologically-influenced corrosion. The applicant credits the Lubricating Oil Analysis Program and the One-time Inspection Program for managing loss of material due to pitting, crevice, microbiologically influence corrosion. The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection Program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting, crevice and microbiologically-influenced corrosion and 2) will provide for one-time inspections of select components exposed to lubricating oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion in susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program. The staff noted that one-time inspection is an acceptable method to determine whether or not loss of material is occurring slowly such that the intended function will be maintained during the period of extended operation. The staff finds that the Lubricating Oil Analysis Program and the One-Time Inspection Program are adequate to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion for these copper alloy components exposed to lubricating oil through the period of extended operation.

In LRA Table 3.4.2-6, the applicant stated that for glass tank and sight glasses in air-gas wetted internal environment there are no aging effects requiring management. The applicant referenced footnote "G" for this line item indicating that environment is not listed in the GALL Report for this material and component combination.

As indicated in "Corrosion Handbook" by H.H.Uhlig, the staff noted that glass as a material is impervious to normal plant environments. This conclusion is based on industry experience where the staff noted that no failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at temperatures or during time periods of concern for extended operation. The staff acknowledges that the use of glass in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation, since air-gas wetted internal environment does not contain hydroflouric acid or caustics. Based on this review and on the industry operating experience, the staff finds that glass in an air-gas wetted internal environment will not have any aging effects requiring aging management.

In LRA Table 3.4.2-6, the applicant stated that for polytetrafluoroethylene (PTFE) piping and fittings in treated water and air-indoor environments, there are no aging effects requiring management. The applicant referenced footnote "F" for this line item indicating that material is not listed in the GALL Report for this component and environment combination.

As identified in "Engineering Materials Handbook – Engineering Plastics," the staff noted that PTFE is a thermoplastic member of the fluoropolymer family of plastics and has a low coefficient of friction, excellent insulating properties, and is chemically inert to most substances. The staff also noted that unlike metals, thermoplastics do not display corrosion rates, and rather than depend on an oxide layer for protection, they depend on chemical resistance to the environments to which they are exposed. The use of thermoplastics in power plant environments is a design-driven criterion. The staff acknowledges that PTFE is an impervious material and once selected for the environment will not have any significant age related degradation. The staff has not observed any age related industry experience for PTFE material in treated water and air-indoor environments. Based on this review, the staff finds that for PTFE piping and fittings in treated water and air-indoor environments there are no aging effects requiring management.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of combinations of material, environment, AERM, and AMP not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed, so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.7 Steam and Power Conversion System – Main Steam System – Summary of Aging Management Evaluation – LRA Table 3.4.2-7

The staff reviewed LRA Table 3.4.2-7, which summarizes the results of AMRs for the main steam system component groups.

In LRA Table 3.4.2-7, the applicant proposed to manage cracking due to stress corrosion cracking (SCC) for piping and fittings and valve bodies made of copper alloy with 15% or greater zinc exposed to an environment of treated water (internal) using the Water Chemistry Program and the One-Time Inspection Program. For these components the applicant cited generic note H, indicating that the aging effect is not in the GALL Report for this component, material and environment combination. The applicant also cited a plant-specific note stating that the aging effects/mechanisms for copper alloy with 15% or greater zinc in a treated water environment include cracking due to SCC.

The staff confirmed that the GALL Report does not list cracking due to SCC as an aging effect applicable for copper alloy with 15% or greater zinc exposed to treated water. The staff also reviewed selected portions of EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4, dated January 2006. The staff noted that Section 3.2.2, Appendix A of the EPRI report states that in the presence of ammonia or other ammonium compounds that may be used in treated water systems, cracking due to SCC can occur in copper alloys containing 15% or greater zinc. On the basis that the aging effect is identified in the EPRI report, the staff finds the applicant's identification of cracking due to SCC in copper components exposed to treated water acceptable.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that Water Chemistry Program, with an enhancement, is consistent with GALL AMP XI.M2, "Water Chemistry." The staff reviewed the applicant's One-Time Inspection Program and its evaluation is documented in SER Section 3.0.3.2.14. The staff finds that the One-Time Inspection Program is consistent with GALL AMP XI.M32, "One-Time

Inspection," and is adequate to detect the presence or note the absence of cracking due to SCC for components within the scope of the program. Based on the staff's determination that the Water Chemistry Program provides mitigation and the One-Time Inspection Program provides detection for the potential aging effect of cracking due to SCC, the staff finds the applicant's proposed AMPs for managing the aging effect of cracking due to SCC in piping and fittings and valve bodies made of copper alloy with 15% or greater zinc exposed to an environment of treated water in the main steam system acceptable.

In LRA Table 3.4.2-7, the applicant proposed to manage loss of material due to general corrosion for carbon steel and low alloy steel piping and fittings and for carbon steel valve bodies exposed to an environment of steam (internal) using the Water Chemistry Program. For these components the applicant cited generic note H, indicating that the aging effect is not in the GALL Report for this component, material and environment combination. The applicant also cited a plant-specific note stating that the aging effects/mechanisms for carbon steel and low alloy steel in a steam environment include loss of material due to general corrosion.

The staff noted that in the GALL Report, Volume 1, Table 4, Item 37 provides aging management results for steel, stainless steel and nickel-based alloy piping, piping components, and piping elements exposed to steam in the main steam system. The staff also noted that this AMR result line identifies the aging effect as loss of material due to pitting and crevice corrosion and recommends use of the Water Chemistry Program to manage the aging effect. Because the GALL Report line item for these main steam piping components does not explicitly list general corrosion as an aging mechanism that may cause loss of material in carbon steel piping and piping components exposed to a steam environment, the staff finds the applicant's identification of loss of material due to general corrosion for carbon steel valve bodies exposed to a steam environment acceptable.

The staff reviewed the applicant's Water Chemistry Program and its evaluation is documented in SER Section 3.0.3.2.2. The staff finds that the program, with an enhancement, is consistent with GALL AMP XI.M2, "Water Chemistry." The staff noted that in the SRP-LR, Table 3.4-1, Item 37, the AMP recommended for managing the aging effect of loss of material due to pitting and crevice corrosion for steel piping and fittings in a steam environment is the Water Chemistry Program, alone. The staff also noted that the applicant proposed to manage the same aging effect due to a different mechanism (general corrosion) using the same program as recommended in SRP-LR, Table 3.4-1, item 37. Based on the staff's determination that the applicant's Water Chemistry Program is consistent with the GALL Report AMP and on the SRP-LR's recommendation of the Water Chemistry Program, alone, for managing the aging effect of corrosion in a steam environment, the staff finds the applicant's proposed AMP for managing the aging effect of loss of material due to general corrosion in carbon steel and low alloy steel piping and fittings and carbon steel valve bodies exposed to an environment of steam in the main steam system to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation as required by 10 CFR 54.21(a)(3).

3.4.2.3.8 Steam and Power Conversion System – Steam Turbine and Auxiliary Systems – Summary of Aging Management Evaluation – LRA Table 3.4.2-8

The staff reviewed LRA Table 3.4.2-8, which summarizes the results of AMRs for the steam turbine and auxiliary systems component groups.

In LRA Table 3.4.2-8, the applicant proposed to manage loss of material due to erosion for carbon steel material for piping and fittings exposed to an external treated water environment using the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. The AMR line items cite Generic Note H, which indicates that the aging effect is not addressed in the GALL Report for this component, material and environment combination.

Based on the staff's review of this AMR item, the staff determined that additional information was needed regarding the applicant's proposed AMP for this AMR item. In RAI 3.4.2-8-1, dated October 15, 2008 the staff requested that the applicant provide additional information clarifying how the inspection of the internal surface of piping and fittings will be representative of the aging and degradation that would be occurring from the external treated water environment.

In its response to the RAI dated November 12, 2008, the applicant stated that the configuration of the carbon steel piping and fitting that this AMR line item references. Based on the applicant's clarification, the staff noted that the piping and fittings are internal to the main condenser steam space, but are subject to loss of material due to erosion on the external surface of the piping and fittings.

Based on its review, the staff finds the applicant's response to RAI 3.4.2-8-1 acceptable because the applicant clarified that Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program was chosen because these components are internal to the main condenser steam space, but the external surface of these components is subject to erosion and exposed to this environment. The staff's concern described in RAI 3.4.2-8-1 is resolved.

The staff reviewed the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components Program and its evaluation is documented in SER Section 3.0.3.2.17. The staff finds that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program performs periodic visual inspections of internal surfaces during periodic system and component surveillance activities or during maintenance activities when the internal surface is accessible for visual inspections to detect aging effects that could result in a loss of the component's intended function. On the basis of its review, the staff finds that because these components will be inspected periodically by visual inspections when exposed to an internal environment of treated water they will be adequately managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program.

In LRA Table 3.4.2-8, the applicant designated Note G for Aluminum Alloy Valve Bodies and Note H for copper alloy piping, fittings, filter housings, heat exchanger components, pump casings, and valve bodies exposed to a lubricating oil environment in the steam turbine and auxiliaries system because the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report for the copper alloy components and the environment is not in the GALL Report for the aluminum alloy components. The staff reviewed the GALL Report and found that the AMR line item, piping and fittings is not evaluated for a lubricating oil environment for loss of material due to pitting, crevice, microbiologically influence corrosion and that the GALL Report does not address aluminum filter housings exposed to lubricating oil and accordingly Note G is appropriate. The applicant credits the Lubricating Oil

Analysis Program and the One-time Inspection Program for managing loss of material due to pitting, crevice, microbiologically-influenced corrosion. The staff reviewed the Lubricating Oil Analysis Program and the One-Time Inspection program and its evaluations are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.14, respectively. The staff finds that these programs 1) provide for periodic sampling of lubricating oil to maintain contaminants at acceptable limits to preclude loss of material due to pitting, crevice and microbiologically-influenced corrosion and 2) will provide for one-time inspections of select components exposed to lubricating oil for loss of material due to pitting, crevice and microbiologically-influenced corrosion at susceptible locations to verify the effectiveness of the Lubricating Oil Analysis Program. The staff noted that one-time inspection is an acceptable method to determine whether or not loss of material is occurring slowly such that the intended function will be maintained during the period of extended operation. The staff finds that the Lubricating Oil Analysis Program and the One-Time Inspection Program are adequate to manage loss of material due to pitting, crevice, and microbiologically-influenced corrosion for these aluminum and copper alloy components exposed to lubricating oil through the period of extended operation.

In LRA Table 3.4.2-8, the applicant stated that for glass sight glasses in air–gas wetted internal environment there are no aging effects requiring management. The applicant referenced footnote "G" for this line item indicating that environment is not listed in the GALL Report for this material and component combination.

As indicated in "Corrosion Handbook" by H.H.Uhlig, the staff noted that that glass as a material is impervious to normal plant environments. This conclusion is based on industry experience where the staff noted that no failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at temperatures or during time periods of concern for extended operation. The staff acknowledges that the use of glass in power plant environments is a design-driven criterion and once selected for the environment will not have any significant age related degradation, since air-gas wetted internal environment does not contain hydroflouric acid or caustics. Based on this review and on the industry operating experience, the staff finds that glass in an air-gas wetted internal environment will not have any aging effects requiring aging management.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.3 Conclusion

The staff concludes that the applicant has provided sufficient information to demonstrate that the effects of aging for the steam and power conversion system components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5 Aging Management of Containments, Structures, and Component Supports

This section of the SER documents the staff's review of the applicant's AMR results for the containments, structures, and component supports of the following:

- Air Intake Structures
- Auxiliary Building
- Circulating Water Pump House
- Control Building
- Diesel Generator Building
- Dike/Flood Control System
- Fuel Handling Building
- Intake Screen and Pump House
- Intermediate Building
- Mechanical Draft Cooling Tower Structures
- Miscellaneous Yard Structures
- Natural Draft Cooling Tower
- Structural Commodities
- Reactor Building (containment)
- SBO Diesel Generator Building
- Service Building
- Component Supports Commodity Group
- Substation Structures
- Turbine Building
- UPS Diesel Building

3.5.1 Summary of Technical Information in the Application

LRA Section 3.5 provides AMR results for structures, structural components, and component supports. LRA Table 3.5.1, "Summary of Aging Management Evaluations for Structures and Component Supports," is a summary comparison of the applicant's AMRs with those evaluated in the GALL Report.

The applicant's AMRs evaluated and incorporated applicable plant-specific and industry operating experience in the determination of AERMs. The plant-specific evaluation included condition reports and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.5.2 Staff Evaluation

The staff reviewed LRA Section 3.5 to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging for the containment, structures and component supports within the scope of license renewal and subject to an AMR, will be

adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff conducted a review of the AMRs to confirm the applicant's claim that certain AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs. The following programs are credited for managing the aging effects for the structures and component supports:

- Structures Monitoring Program
- Boric Acid Corrosion
- Selective leaching of Material
- Buried Piping and Tank Inspection
- One-Time Inspection
- Water Chemistry
- 10 CFR Part 50, Appendix J
- ASME Section XI, Subsection – IWE
- ASME Section XI, Subsection – IWF
- ASME Section XI, Subsection – IWL
- External Surfaces Monitoring
- TLAA

The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Section 3.5.2.1 and 3.5.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff's evaluation are discussed in SER Section 3.5.2.3.

For components which the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's operating experience to verify the applicant's claims.

Table 3.5-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.5 and addressed in the GALL Report.

Table 3.5-1 Staff Evaluation for Containments, Structures, and Component Supports in the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Concrete elements: walls, dome, basemat, ring girder, buttresses, containment (as applicable). (3.5.1-1)	Aging of accessible and inaccessible concrete areas due to aggressive chemical attack, and corrosion of embedded steel	ISI (IWL) and for inaccessible concrete, an examination of representative samples of below-grade concrete, and periodic monitoring of groundwater if environment is non-aggressive. A plant specific program is to be evaluated if environment is aggressive.	Yes	ISI (IWL) for containment concrete Structures Monitoring Program for groundwater monitoring Boric Acid Corrosion	Consistent with GALL Report (See SER Sections 3.5.2.1.2 and 3.5.2.2.1)
Concrete elements; All (3.5.1-2)	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes	Not applicable	See SER Section 3.5.2.2.1
Concrete elements: foundation, sub-foundation (3.5.1-3)	Reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation	Structures Monitoring Program If a de-watering system is relied upon to control erosion of cement from porous concrete subfoundations, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes	Not applicable	See SER Section 3.5.2.2.1
Concrete elements: dome, wall, basemat, ring girder, buttresses, containment, concrete fill-in annulus (as applicable) (3.5.1-4)	Reduction of strength and modulus of concrete due to elevated temperature	A plant-specific aging management program is to be evaluated.	Yes	Not applicable	See SER Section 3.5.2.2.1

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel elements: drywell; torus; drywell head; embedded shell and sand pocket regions; drywell support skirt; torus ring girder; downcomers; liner plate, ECCS suction header, support skirt, region shielded by diaphragm floor, suppression chamber (as applicable) (3.5.1-5)	Loss of material due to general, pitting and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	Yes	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)
Steel elements: steel liner, liner anchors, integral attachments (3.5.1-6)	Loss of material due to general, pitting and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	Yes	ISI (IWE) and 10 CFR Part 50, Appendix J	Consistent with GALL Report, (See SER Section 3.5.2.2.1)
Prestressed containment tendons (3.5.1-7)	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Consistent with GALL Report (See SER Section 3.5.2.2.1)
Steel and stainless steel elements: vent line, vent header, vent line bellows; downcomers; (3.5.1-8)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)
Steel, stainless steel elements, dissimilar metal welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers (3.5.1-9)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA - Metal fatigue	Consistent with GALL Report (See SER Section 3.5.2.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Stainless steel penetration sleeves, penetration bellows, dissimilar metal welds (3.5.1-10)	Cracking due to stress corrosion cracking	ISI (IWE) and 10 CFR Part 50, Appendix J, and additional appropriate examinations/ evaluations for *bellows assemblies* and dissimilar metal welds.	Yes	Not applicable	See SER Section 3.5.2.2.1
Stainless steel vent line bellows, (3.5.1-11)	Cracking due to stress corrosion cracking	ISI (IWE) and 10 CFR Part 50, Appendix J, and additional appropriate examination/ evaluation for bellows assemblies and dissimilar metal welds.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.5.2.1.1)
Steel, stainless steel elements, dissimilar metal welds: penetration sleeves, penetration bellows; suppression pool shell, unbraced downcomers (3.5.1-12)	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J, and supplemented to detect fine cracks	Yes	ISI (IWE) and 10 CFR Part 50, Appendix J	Consistent with GALL Report (See SER Section 3.5.2.2.1)
Steel, stainless steel elements, dissimilar metal welds: torus; vent line; vent header; vent line bellows; downcomers (3.5.1-13)	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J, and supplemented to detect fine cracks	Yes	Not applicable	Not applicable to PWRs (See SER Section 3.5.2.1.1)
Concrete elements: dome, wall, basemat ring girder, buttresses, containment (as applicable) (3.5.1-14)	Loss of material (scaling, cracking, and spalling) due to freeze-thaw	ISI (IWL). Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557).	Yes	ISI (IWL).	Consistent with GALL Report (See SER Section 3.5.2.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Concrete elements: walls, dome, basemat, ring girder, buttresses, containment, concrete fill-in annulus (as applicable). (3.5.1-15)	Cracking due to expansion and reaction with aggregate; increase in porosity, permeability due to leaching of calcium hydroxide	ISI (IWL) for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R.	Yes	ISI (IWL)	Consistent with GALL Report, (See SER Section 3.5.2.2.1)
Seals, gaskets, and moisture barriers (3.5.1-16)	Loss of sealing and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	ISI (IWE) and 10 CFR Part 50, Appendix J	No	ISI (IWE) and 10 CFR Part 50, Appendix J	Consistent with GALL Report, (See SER Section 3.5.2.1)
Personnel airlock, equipment hatch and CRD hatch locks, hinges, and closure mechanisms (3.5.1-17)	Loss of leak tightness in closed position due to mechanical wear of locks, hinges and closure mechanisms	10 CFR Part 50, Appendix J and plant Technical Specifications	No	App. J and Plant Technical Specification program	Consistent with GALL Report, (See SER Section 3.5.2.1)
Steel penetration sleeves and dissimilar metal welds; personnel airlock, equipment hatch and CRD hatch (3.5.1-18)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	No	IWE, and App. J	Consistent with GALL Report, (See SER Section 3.5.2.1)
Steel elements: stainless steel suppression chamber shell (inner surface) (3.5.1-19)	Cracking due to stress corrosion cracking	ISI (IWE) and 10 CFR Part 50, Appendix J	No	Not applicable	Not applicable to BWRs (See SER Section 3.5.2.1.1)
Steel elements: suppression chamber liner (interior surface) (3.5.1-20)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	No	Not applicable	Not applicable to BWRs (See SER Section 3.5.2.1.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel elements: drywell head and downcomer pipes (3.5.1-21)	Fretting or lock up due to mechanical wear	ISI (IWE)	No	Not applicable	Not applicable to BWRs (See SER Section 3.5.2.1.1)
Prestressed containment: tendons and anchorage components (3.5.1-22)	Loss of material due to corrosion	ISI (IWL)	No	ISI (IWL)	Consistent with GALL Report, (See SER Section 3.5.2.1)
All Groups except Group 6: interior and above grade exterior concrete (3.5.1-23)	Cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel	Structures Monitoring Program	Yes	Structures Monitoring Program Boric Acid Corrosion	Consistent with GALL Report (See SER Section 3.5.2.1.3)
All Groups except Group 6: interior and above grade exterior concrete (3.5.1-24)	Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack	Structures Monitoring Program	Yes	Structures Monitoring Program Boric Acid Corrosion	Consistent with GALL Report (See SER Section 3.5.2.1.4)
All Groups except Group 6: steel components: all structural steel (3.5.1-25)	Loss of material due to corrosion	Structures Monitoring Program. If protective coatings are relied upon to manage the effects of aging, the Structures Monitoring Program is to include provisions to address protective coating monitoring and maintenance.	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
All Groups except Group 6: accessible and inaccessible concrete: foundation (3.5.1-26)	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Structures Monitoring Program. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557).	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
All Groups except Group 6: accessible and inaccessible interior/exterior concrete (3.5.1-27)	Cracking due to expansion due to reaction with aggregates	Structures Monitoring Program. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.2.2)
Groups 1-3, 5-9: All (3.5.1-28)	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.2.2)
Groups 1-3, 5-9: foundation (3.5.1-29)	Reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation	Structures Monitoring Program. If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes	Not applicable	Not Applicable to TMI-1 (See SER Section 3.5.2.2.2)
Group 4: radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; steam generator supports (3.5.1-30)	Lock-up due to wear	ISI (IWF) or Structures Monitoring Program	Yes	ISI (IWF) or Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.2.2)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Groups 1-3, 5, 7-9: below-grade concrete components, such as exterior walls below grade and foundation (3.5.1-31)	Increase in porosity and permeability, cracking, loss of material (spalling, scaling), aggressive chemical attack; cracking, loss of bond, and loss of material (spalling, scaling), corrosion of embedded steel	Structures Monitoring Program; examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is non-aggressive. A plant specific program is to be evaluated if environment is aggressive.	Yes	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.2.2)
Groups 1-3, 5, 7-9: exterior above and below grade reinforced concrete foundations (3.5.1-32)	Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide	Structures Monitoring Program for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.2.2)
Groups 1-5: concrete (3.5.1-33)	Reduction of strength and modulus due to elevated temperature	A plant-specific aging management program is to be evaluated	Yes	Not applicable	See SER Section 3.5.2.2.2
Group 6: concrete; all (3.5.1-34)	Increase in porosity and permeability, cracking, loss of material due to aggressive chemical attack; cracking, loss of bond, loss of material due to corrosion of embedded steel	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs and for inaccessible concrete, an examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is non-aggressive. A plant specific program is to be evaluated if environment is aggressive.	Yes	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.2.2)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Group 6: exterior above and below grade concrete foundation (3.5.1-35)	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557).	Yes	Structure Monitor Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Group 6: all accessible and inaccessible reinforced concrete (3.5.1-36)	Cracking due to expansion / reaction with aggregates	Accessible areas: Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Group 6: exterior above and below grade reinforced concrete foundation interior slab (3.5.1-37)	Increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide	For accessible areas, Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.2.)
Groups 7, 8: tank liners (3.5.1-38)	Cracking due to stress corrosion cracking; loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated	Yes	Not applicable	Not Applicable to TMI-1 (See SER Section 3.5.2.2.2)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Support members; welds; bolted connections; support anchorage to building structure (3.5.1-39)	Loss of material due to general and pitting corrosion	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.1)
Building concrete at locations of expansion and grouted anchors; grout pads for support base plates (3.5.1-40)	Reduction in concrete anchor capacity due to local concrete degradation, service-induced cracking or other concrete aging mechanisms	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.1)
Vibration isolation elements (3.5.1-41)	Reduction or loss of isolation function, radiation hardening, temperature, humidity, sustained vibratory loading	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.1)
Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds (3.5.1-42)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	Not applicable	Not applicable to TMI-1 (See SER Section 3.5.2.2.2)
Groups 1-3, 5, 6: all masonry block walls (3.5.1-43)	Cracking due to restraint shrinkage, creep, and aggressive environment	Masonry Wall Program	No	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.1.5)
Group 6: elastomer seals, gaskets, and moisture barriers (3.5.1-44)	Loss of sealing due to deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.1)
Group 6: exterior above and below grade concrete foundation; interior slab (3.5.1-45)	Loss of material due to abrasion, cavitation	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance	No	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Group 5: fuel pool liners (3.5.1-46)	Cracking due to stress corrosion cracking; loss of material due to pitting and *crevice* corrosion	Water Chemistry and monitoring of spent fuel pool water level in accordance with technical *specifications and* leakage from the leak chase channels.	No	Water Chemistry Control Program	Consistent with GALL Report, (See SER Section 3.5.2.1)
Group 6: all metal structural members (3.5.1-47)	Loss of material due to general (steel only), pitting and crevice corrosion	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance. If protective coatings are relied upon to manage aging, protective coating monitoring and maintenance provisions should be included.	No	Structures Monitoring Program	Consistent with GALL Report (See SER Sections 3.3.2.1.3, 3.2.2.1.4)
Group 6: earthen water control structures - dams, embankments, reservoirs, channels, canals, and ponds (3.5.1-48)	Loss of material, loss of form due to erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, Seepage	Inspection of Water-Control Structures or FERC/US Army Corps of Engineers dam inspections and maintenance programs	No	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.1)
Support members; welds; bolted connections; support anchorage to building structure (3.5.1-49)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and ISI (IWF)	No	Water Chemistry and IWF Program	Consistent with GALL Report, (See SER Section 3.5.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Groups B2, and B4: galvanized steel, aluminum, stainless steel support members; welds; bolted connections; support anchorage to building structure (3.5.1-50)	Loss of material due to pitting and crevice corrosion	Structures Monitoring Program	No	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Aboveground Steel Tanks External Surfaces Monitoring Program Structures Monitoring Program	Consistent with GALL Report (See SER Sections 3.5.2.1.6 and 3.4.2.1.3, 3.3.2.1.3, 3.2.2.1.4)
Group B1.1: high strength low-alloy bolts (3.5.1-51)	Cracking due to stress corrosion cracking; loss of material due to general corrosion	Bolting Integrity	No	Not Applicable	Not Applicable to TMI-1 (See SER Section 3.5.2.1.1)
Groups B2, and B4: sliding support bearings and sliding support surfaces (3.5.1-52)	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with GALL Report, (See SER Section 3.5.2.1)
Groups B1.1, B1.2, and B1.3: support members: welds; bolted connections; support anchorage to building structure (3.5.1-53)	Loss of material due to general and pitting corrosion	ISI (IWF)	No	IWF Program	Consistent with GALL Report, (See SER Section 3.5.2.1)
Groups B1.1, B1.2, and B1.3: constant and variable load spring hangers; guides; stops; (3.5.1-54)	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	No	ISI (IWF)	Consistent with GALL Report, (See SER Section 3.5.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Steel, galvanized steel, and aluminum support members; welds; bolted connections; support anchorage to building structure (3.5.1-55)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Boric Acid Corrosion	Consistent with GALL Report, (See SER Section 3.5.2.1)
Groups B1.1, B1.2, and B1.3: sliding surfaces (3.5.1-56)	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	No	ISI (IWF)	Consistent with GALL Report, (See SER Section 3.5.2.1)
Groups B1.1, B1.2, and B1.3: vibration isolation elements (3.5.1-57)	Reduction or loss of isolation function, radiation hardening, temperature, humidity, sustained vibratory loading	ISI (IWF)	No	Not applicable	Not applicable to TMI-1 (See SER Section 3.5.2.1.1)
Galvanized steel and aluminum support members; welds; bolted connections; support anchorage to building structure exposed to air - indoor uncontrolled (3.5.1-58)	None	None	No	None	Consistent with GALL Report, (See SER Section 3.5.2.1)
Stainless steel support members; welds; bolted connections; support anchorage to building structure (3.5.1-59)	None	None	No	None	Consistent with GALL Report, (See SER Section 3.5.2.1)

The staff's review of the containments, structures, and component support groups followed several approaches. One approach, documented in SER Section 3.5.2.1, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.5.2.2, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.5.2.3, discusses the staff's review of AMR results for components the applicant indicated are not consistent with, or not addressed in, the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the containments, structures, and component supports is documented in SER Section 3.0.3.

3.5.2.1 AMR Results That Are Consistent with the GALL Report

LRA Section 3.5.2.1, identifies the materials, environments, and AERMs. The applicant identified the following programs that manage the effects of aging related to structures and component supports:

- Structures Monitoring Program
- Boric Acid Corrosion
- Selective Leaching of Material
- Buried Piping and Tank Inspection
- One-Time Inspection
- Water Chemistry
- 10 CFR Part 50, Appendix J
- ASME Section XI, Subsection – IWE
- ASME Section XI, Subsection – IWF
- ASME Section XI, Subsection – IWL
- External Surfaces Monitoring
- Water Chemistry
- TLAA

In LRA Tables 3.5.2-1 through 3.5.2-20, the applicant summarized AMRs for structures and component supports and indicated AMRs claimed to be consistent with the GALL Report. For component groups evaluated in the LRA for which the applicant claimed consistency with the GALL Report and for which the GALL Report does not recommend further evaluation, the staff's review determined whether the plant-specific components groups were bounded by the GALL Report evaluation.

For each AMR line item the applicant noted how the information in the tables aligns with the information in the GALL Report. The staff reviewed those AMRs with notes A through E indicating how the AMR is consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff audited these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the GALL Report AMP. The staff audited these line items to verify consistency with the GALL Report and verified that the identified exceptions to the GALL AMPs have been reviewed and accepted. The staff also determined whether the applicant's AMP was consistent with the GALL Report AMP and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the staff verified that the AMP is consistent with the GALL Report AMP. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component with the same material, environment, aging effect, and AMP as the component under review. The staff audited these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component was applicable to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the GALL Report AMP. The staff audited these line items to verify consistency with the GALL Report. The staff verified whether the AMR line item of the different component was applicable to the component under review and verified whether the identified exceptions to the GALL Report AMPs have been reviewed and accepted. The staff also determined whether the applicant's AMP was consistent with the GALL Report AMP and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but credits a different AMP. The staff audited these line items to verify consistency with the GALL Report. The staff also determined whether the credited AMP would manage the aging effect consistently with the GALL Report AMP and whether the AMR was valid for the site-specific conditions.

The staff reviewed the information in the LRA, as documented in the SER Section 3.5.2.1. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs. The staff's evaluation is discussed below.

3.5.2.1.1 AMR Results Identified as Not Applicable

LRA Table 3.5.1 Items 5, 8, 11, 13, 19, 20, and 21 are identified as "Not Applicable" because they apply only to BWR containments. The staff confirmed that the applicant identified the correct items as being not applicable for this reason.

LRA Table 3.5.1, Items 51 and 57 are identified as "Not Applicable" since the component, material, and environment combination does not exist at TMI-1. For each of these line items, the staff reviewed the LRA and the applicant's supporting documents, and confirmed the applicant's claim that the component, material, and environment combination does not exist at TMI-1. Since TMI-1 does not have the component, material, and environment combination for these Table 1 line items, the staff finds that these AMRs are not applicable to TMI-1.

3.5.2.1.2 Aging of Accessible and Inaccessible Concrete Areas Due to Aggressive Chemical Attack, and Corrosion of Embedded Steel

LRA Table 3.5.1, Item 3.5.1-1 states that the ASME Section XI, Subsection IWL Program will be used to manage aging effects due to aggressive chemical attack, and corrosion of embedded steel of reactor building (containment) reinforced concrete in accessible areas. The LRA also states that the Boric Acid Corrosion Program will also be used to manage the aging effect/mechanism in areas subject to borated water leakage. During the review of LRA Tables

3.5.2-1 through 3.5.2-20, the staff noted that for the AMR results line that points to item 3.5.1-1 in LRA Table 3.5.1, the applicant included fourteen groups that reference Note E and plant-specific Note 1 or Note 5 (depending on the table), which both state "The aging effects/mechanisms of reinforced concrete in an air with borated water leakage environment include cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel. These aging effects/mechanisms are managed by the Boric Acid Corrosion Program."

The staff reviewed the AMR results lines referenced to Note E, plant-specific Note 1 and Note 5, and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.S2, "ASME Section XI, Subsection IWL," the applicant has additionally proposed using the Boric Acid Corrosion Program. The GALL Report line item referenced is for concrete elements: walls, basemat, buttresses, containment, etc., and therefore, the GALL Report recommends AMP XI.S2. The applicant stated that the AMR result line items that reference item 3.5.1-1 in LRA Table 3.5.1, are also located in the areas subject to borated water leakage, and, therefore, the Boric Acid Corrosion Program was also credited. The staff reviewed the Boric Acid Corrosion Program and ASME Section XI, Subsection IWL Program and found that both require visual inspections on a periodic basis to manage aggressive chemical attack due to borated water leakage. On the basis that periodic visual inspections are performed, the staff finds the applicant's additional use of the Boric Acid Corrosion Program to be acceptable.

Based on a review of the programs identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.1.3 Cracking, Loss of Bond, and Loss of Material (spalling, scaling) Due to Corrosion of Embedded Steel

In the discussion section of LRA Table 3.5.1, Item 3.5.1-23, the applicant stated that cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel is managed by the Structures Monitoring Program. The Boric Acid Corrosion Program will also be used to manage the aging effect/mechanism in areas subject to borated water leakage. During the review of LRA Tables 3.5.2-1 through 3.5.2-20, the staff noted that for the AMR results line pointing to Table 3.5.1, item 3.5.1-23, for twenty-six groups the applicant included a reference to Note E and plant-specific Note 1, which states "the aging effects/mechanisms of reinforced concrete in an air with borated water leakage environment include cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel. These aging effects/mechanisms are managed by the Boric Acid Corrosion Program."

The staff reviewed the AMR results lines referenced to Note E, plant-specific Note 1, and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.S6, "Structures Monitoring Program," the applicant has additionally proposed using the Boric Acid Corrosion Program. The GALL Report line item referenced is reinforced concrete, and therefore, the GALL Report recommends AMP XI.S6. The applicant stated that the AMR result line items that reference LRA Table 3.5.1 item 3.5.1-23 are also located in the areas subject to borated water leakage, and, therefore, the Boric Acid Corrosion Program was also credited. The staff reviewed the Boric Acid Corrosion Program and Structures Monitoring

Program and found that both require visual inspections on a periodic basis to manage aggressive chemical attack due to borated water leakage. On the basis that periodic visual inspections are performed, the staff finds the applicant's additional use of the Boric Acid Corrosion Program to be acceptable.

Based on a review of the programs identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.1.4 Increase in Porosity and Permeability, Cracking, Loss of Material (spalling, scaling) Due to Aggressive Chemical Attack

In the discussion section of LRA Table 3.5.1, item 3.5.1-24, the applicant stated that increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack is managed by the Structures Monitoring Program. The Boric Acid Corrosion Program will also be used to manage the aging effect/mechanism in areas subject to borated water leakage. During the review of LRA Tables 3.5.2-1 through 3.5.2-20, the staff noted that for the AMR results line pointing to Table 3.5.1, item 3.5.1-24, for twenty-six groups the applicant included a reference to Note E and plant-specific Note 5 or 6 (depending on the table), which states "the aging effects/mechanisms of reinforced concrete in an air with borated water leakage environment include cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel. These aging effects/mechanisms are managed by the Boric Acid Corrosion Program."

The staff reviewed the AMR results lines referenced to Note E, plant-specific Note 5 and 6, and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.S6, "Structures Monitoring Program," the applicant has additionally proposed using the Boric Acid Corrosion Program. The GALL Report line item referenced is reinforced concrete, and therefore, the GALL Report recommends AMP XI.S6. The applicant stated that the AMR result line items that reference LRA table 3.5.1 item 3.5.1-24 are also located in the areas subject to borated water leakage, and, therefore, the Boric Acid Corrosion Program was also credited. The staff reviewed the Boric Acid Corrosion Program and Structures Monitoring Program and found that both require visual inspections on a periodic basis to manage aggressive chemical attack due to borated water leakage. On the basis that periodic visual inspections are performed, the staff finds the applicant's additional use of the Boric Acid Corrosion Program to be acceptable.

Based on a review of the programs identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.1.5 Cracking Due to Restraint Shrinkage, Creep, and Aggressive Environment for Masonry Block Walls

In the discussion section of LRA Table 3.5.1, item 3.5.1-43, the applicant stated that cracking due to restraint shrinkage, creep, and aggressive environment is managed by Structures Monitoring Program. The Boric Acid Corrosion Program will also be used to manage the aging effect/mechanism in areas subject to borated water leakage. During the review of LRA Tables 3.5.2-1 through 3.5.2-20, the staff noted that for the AMR results line pointing to Table 3.5.1, item 3.5.1-43, for one group the applicant included a reference to Note E and plant-specific Note 6, which states "the aging effects/mechanisms of reinforced concrete in an air with borated water leakage environment include cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel. These aging effects/mechanisms are managed by the Boric Acid Corrosion Program."

The staff reviewed the AMR results lines referenced to Note E, plant-specific Note 6, and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends AMP XI.S6, "Structures Monitoring Program," the applicant has additionally proposed using the Boric Acid Corrosion Program. The GALL Report line item referenced is reinforced concrete, and therefore, the GALL Report recommends AMP XI.S6. The applicant stated that the AMR result line item that references LRA Table 3.5.1 item 3.5.1-43 is also located in the areas subject to borated water leakage, and, therefore, the Boric Acid Corrosion Program was also credited. The staff reviewed the Boric Acid Corrosion Program and Structures Monitoring Program and found that both are performing visual inspections on a periodic basis to manage aggressive chemical attack due to borated water leakage. On the basis that periodic visual inspections are performed, the staff finds the applicant's additional use of the Boric Acid Corrosion Program to be acceptable.

Based on a review of the programs identified above, the staff determines that the applicant's proposed programs are acceptable for managing the aging effects in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.1.6 Loss of Material Due to Pitting and Crevice Corrosion

In the discussion section of LRA Table 3.5.1, item 3.5.1-50, the applicant stated that loss of material due to pitting and crevice corrosion is managed by Structures Monitoring Program. The External Surfaces Monitoring Program will also be used to monitor loss of material due to pitting and crevice corrosion of piping and component insulation jacketing. During the review of LRA Tables 3.5.2-1 through 3.5.2-20, the staff noted that for the AMR results line pointing to Table 3.5.1, item 3.5.1-50, for two groups the applicant included a reference to Note E and plant-specific Note 4 or Note 5 which both state, "the aging effects of aluminum (Note 4) or stainless steel (Note 5) in this environment include loss of material due to pitting and crevice corrosion. These aging effects/mechanisms are managed by the External Surfaces Monitoring Program."

The staff reviewed the AMR results lines referenced to Note E, plant-specific Note 4 and Note 5, and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends

AMP XI.S6, "Structures Monitoring Program," the applicant has proposed using the External Surfaces Monitoring Program to monitor loss of material due to pitting and crevice corrosion of piping and component insulation jacketing. The staff reviewed the Structures Monitoring Program and External Surfaces Monitoring Program, and found that both of the programs are performing visual inspections on a periodic basis to manage loss of material due to pitting and crevice corrosion. On the basis that periodic visual inspections are performed, the staff finds the applicant's use of the External Surfaces Monitoring Program to be acceptable.

Based on a review of the programs identified, the staff determines that the applicant's proposed programs are acceptable for managing the aging effect in the applicable components. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation Is Recommended

In LRA Section 3.5.2.2, the applicant further evaluates aging management, as recommended by the GALL Report, for the containments, structures, and component supports, and provides information concerning how it will manage aging effects in the following three areas:

(1) PWR and BWR containments:

- aging of inaccessible concrete areas
- cracks and distortion due to increased stress levels from settlement; reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations if not covered by the Structures Monitoring Program
- reduction of strength and modulus of concrete structures due to elevated temperature
- loss of material due to general, pitting, and crevice corrosion
- loss of prestress due to relaxation, shrinkage, creep, and elevated temperature
- cumulative fatigue damage
- cracking due to SCC
- cracking due to cyclic loading
- loss of material (scaling, cracking, and spalling) due to freeze-thaw
- cracking due to expansion and reaction with aggregate and increase in porosity and permeability due to leaching of calcium hydroxide

(2) Safety-related and other structures and component supports:

- aging of structures not covered by the Structures Monitoring Program
- aging management of inaccessible areas
- reduction of strength and modulus of concrete structures due to elevated temperature
- aging management of inaccessible areas for Group 6 structures
- cracking due to SCC and loss of material due to pitting and crevice corrosion
- aging of supports not covered by the Structures Monitoring Program
- cumulative fatigue damage due to cyclic loading

(3) QA for aging management of nonsafety-related components

For component groups evaluated in the GALL Report for which the applicant had claimed consistency with the GALL Report and for which the GALL Report recommends further evaluation, the staff audited and reviewed the applicant's evaluations to determine whether they adequately address those issues and reviewed the applicant's further evaluations against the criteria in SRP-LR Section 3.5.2.2. Details of the staff's audit are documented in the Audit and Review Report. The staff's evaluation of the aging effects is discussed in the following sections.

3.5.2.2.1 PWR and BWR Containments

The staff reviewed LRA Section 3.5.2.2.1 against the criteria in SRP-LR Section 3.5.2.2.1.

Aging of Inaccessible Concrete Areas. The staff reviewed LRA Section 3.5.2.2.1.1 using the review procedures of SRP-LR Section 3.5.2.2.1.1.

LRA Section 3.5.2.2.1.1 states that the ASME Section XI, Subsection IWL Program is used to manage aging effects due to aggressive chemical attack, and corrosion of embedded steel of reactor building (containment) reinforced concrete. In addition, the applicant stated that the Boric Acid Corrosion Program is also used to manage the aging effect/mechanism in areas subject to borated water leakage. The applicant further stated that historical chemistry results of groundwater water samples have confirmed that groundwater remains non-aggressive to concrete. Groundwater water is periodically monitored as required by the Structures Monitoring Program, and a representative sample of below-grade concrete will be inspected if excavated for any reason.

SRP-LR Section 3.5.3.2.1.1 states that increases in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in inaccessible areas of concrete and steel containments. SRP-LR Section 3.5.2.2.1.1 further states that the existing program relies on ASME Section XI, Subsection IWL to manage these aging effects. The TMI-1 ASME Section XI, Subsection IWL described in LRA Section B.2.1.25 is an existing program that is consistent with all elements of GALL AMP X1.S2 "ASME Section XI, Subsection IWL." The staff's review of the applicant's ASME Section XI, Subsection IWL is documented in SER Section 3.0.3.1.6.

SRP-LR Section 3.5.2.2.1.1 also states that the GALL Report recommends further evaluation of plant-specific programs to manage the aging effects for inaccessible areas if the environment is aggressive. To ensure non-aggressive groundwater chemistries, the GALL Report suggests the periodic groundwater inspection for chlorides, sulfates, and pH. The staff noted that the groundwater monitoring is performed by the Structures Monitoring Program. The staff's review of the applicant's Structures Monitoring Program including periodic monitoring of groundwater is documented in SER Section 3.0.3.2.21.

The staff reviewed the LRA. The staff noted that the sampling results from 1996 presented in the LRA, which indicated a groundwater pH range of 6.1 - 6.7, a chloride range of 3.5 - 210 ppm, and a sulfate range of 14.1 - 410 ppm. During its Structures Monitoring Program AMP audit, the staff asked the applicant (RAI B.2.1.28-1, dated October 7, 2008) to provide the frequency of periodic sampling and the results for the last two samplings of groundwater. In the letter dated October 30, 2008, the applicant stated that the groundwater sampling for pH, chloride, and sulfate concentrations will be performed every 5 years during the period of extended operation. The applicant also demonstrated the last two groundwater samplings include one sample taken in 2007 and three taken in 2005, which showed a pH range of 7.4 – 7.8, a chloride range of 42.4 – 65.5 ppm, and a sulfate range of 27-53.3. Based on the above assertions, the staff confirmed that the below-grade environment at TMI-1 is non-aggressive (pH > 5.5, Chlorides < 500 ppm, and Sulfates <1500 ppm).

The staff noted that TMI-1 concrete is designed in accordance with American Concrete Institute (ACI) 318-63 and constructed in accordance with ACI 301-66. In the LRA, the applicant stated that containment concrete has a water-to-cement ratio of 0.44 with a 5000 psi compressive strength. The staff confirmed that the 0.44 water-to-cement ratio of TMI-1 containment concrete meets the recommendation of ACI 201.2R-77 for a water-to-cement ratio of less than 0.50 for a dense concrete with a low permeability.

On the basis of its review, the staff finds the AMR results to be consistent with the GALL Report. The staff agrees that a plant specific aging management program is not required for inaccessible areas of the reactor building (containment) below-grade concrete for the aging effects of increases in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel because (1) the groundwater water environment is confirmed not aggressive to concrete, (2) the inspection frequency of groundwater chemistries as required by the Structures Monitoring Program agrees with the recommendation of the GALL Report, and (3) the concrete being constructed meets the intent of ACI 201.2R for durability.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.1. For those line items that apply to LRA Section 3.5.2.2.1.1, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Cracks and Distortion due to Increased Stress Levels from Settlement; Reduction of Foundation Strength, Cracking and Differential Settlement due to Erosion of Porous Concrete Subfoundations, if Not Covered by Structures Monitoring Program. The staff reviewed LRA Section 3.5.2.2.1.2 using the review procedures of SRP-LR Section 3.5.2.2.1.2.

LRA Section 3.5.2.2.1.2 states that the cracks and distortion due to increased stress levels from settlement; reduction of foundation strength, cracking and differential settlement due to erosion of porous concrete subfoundations are not aging effects requiring management because (1) the reactor building (containment) base foundation is founded on bedrock and no settlement has been experienced, (2) the containment base foundation is not constructed of porous concrete the, and (3) the containment does not employ a de-watering system for control of settlement.

SRP-LR Section 3.5.2.2.1.2 states that cracks and distortion due to increased stress levels from settlement could occur in concrete and steel containments. Also, reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations could occur in all types of containments. The existing program relies on the Structures Monitoring Program to manage these aging effects. SRP-LR Section 3.5.3.2.1.1 further states that the GALL Report recommends no further evaluation if this activity is within the scope of the applicant's structures monitoring program. The staff reviewed the Structures Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.21.

On the basis of its review, the staff finds that cracks and distortion due to increased stress levels from settlement; reduction of foundation strength, cracking and differential settlement due to erosion of porous concrete subfoundations are not applicable aging effects because conditions necessary for the aging effects, such as soil environment and flowing water environment, as described in associated AMR line items of the GALL Report, Volume 2, do not exist. Therefore, the staff finds that no further evaluation is required.

Reduction of Strength and Modulus of Concrete Structures due to Elevated Temperature. The staff reviewed LRA Section 3.5.2.2.1.3 using the review procedures of SRP-LR Section 3.5.2.2.1.3

The applicant stated in LRA Section 3.5.2.2.1.3 that during normal plant operation, containment concrete general area temperatures do not exceed 150 °F and local area temperatures do not exceed 200 °F.

SRP-LR Section 3.5.2.2.1.3 states that reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR concrete and steel containments. The GALL Report recommends further evaluation of a plant-specific aging management program if any portion of the concrete containment components exceeds specified temperature limits, i.e., general area temperature greater than 66 °C (150 °F) and local area temperature greater than 93 °C (200 °F).

The staff reviewed the LRA and noted that TMI-1 Technical Specification and UFSAR limit the bulk air temperature inside the building, which is maintained by re-circulating air through cooling coils, to 130 °F for areas above elevation 320' and 120 °F below this elevation during normal plant operation. Regarding local area temperatures, the staff also noted that process penetrations in the reactor building wall are provided with a cooling system to limit concrete temperature below 200 °F. On the basis of its review, the staff finds that reduction of strength and modulus of concrete due to elevated temperatures are not applicable aging effects because the conditions necessary for the aging effects, such as elevated temperatures, do not exist. Therefore, the staff finds that no further evaluation is required.

Loss of Material due to General, Pitting and Crevice Corrosion. The staff reviewed LRA Section 3.5.2.2.1.4 using the review procedures of SRP-LR Section 3.5.2.2.1.4.

LRA Section 3.5.2.2.1.4 addresses loss of material due to general, pitting and crevice corrosion for steel elements of accessible and inaccessible areas of containments, stating that the ASME Section XI, Subsection IWE program and the 10 CFR Part 50, Appendix J program are used to manage aging of accessible Containment steel elements. For inaccessible areas, the applicant stated in the LRA that the loss of material due to corrosion is assured to be acceptable because (1) the design of the TMI-1 concrete in accordance with ACI 318-63 and construction in accordance with ACI 301-66 provide a good quality dense concrete with a low permeability, (2) the interior concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the containment liner, (3) the moisture barrier is monitored for aging effects by the ASME Section XI, Subsection IWE Program; this will be performed every refueling outage, and (4) IWE inspections have concluded that the existing liner corrosion is acceptable.

SRP-LR Section 3.5.2.2.1.4 states that loss of material due to general, pitting and crevice corrosion could occur in steel elements of accessible and inaccessible areas for all types of PWR and BWR containments. SRP-LR Section 3.5.2.2.1.4 further states that the existing program relies on ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. LRA Section B.2.1.24 describes the existing ASME Section XI, Subsection IWE program as consistent, with exception, with GALL AMP XI.S1 "ASME Section XI, Subsection IWE." LRA Section B.2.1.27 describes the existing 10 CFR Part 50, Appendix J program as consistent with GALL AMP XI.S4 "10 CFR Part 50, Appendix J." SRP-LR Section 3.5.2.2.1.4 also states that the GALL Report recommends further evaluation of plant-specific programs to manage this aging effect for inaccessible areas if corrosion is significant.

After reviewing the LRA, including the related AMPs with onsite basis document, related TMI-1 operating experience, and discussions with the applicant's technical staff, the staff found that the liner thickness corrosion rate was noticeable from the operating experience of the ASME Section XI, Subsection IWE Program. From the LRA Section on the ASME Section XI, Subsection IWE Program, the staff also noted that the applicant committed to replacing the existing steam generators with new Once Through Steam Generators (OTSGs) prior to entering the period of extended operation. Repair/replacement of reactor building liner plate, removed for access purposes, will be done in accordance with ASME Section XI, Subsection IWE. During the onsite AMP audit, the applicant also indicated that the liner will be restored (weld repair) to full nominal thickness at all locations identified as below 90% before entering the extended operation period. In RAI B.2.1.24-2, dated October 7, 2008, the staff requested that the applicant provide additional information to confirm this and provide the proposed schedule for completion.

The staff's review of the ASME Section XI, Subsection IWE Program including the applicant's response to RAI B.2.1.24-2 is addressed and documented in the SER Section 3.0.3.2.19. The staff further noted from review of the 10 CFR Part 50, Appendix J Program that there were no instances of Appendix J test failures due to causes other than valve or flange seat leakage. For these failures, all conditions were evaluated and corrected in accordance with the 10 CFR Part 50, Appendix J program. The staff's review of the 10 CFR Part 50, Appendix J is documented in SER Section 3.0.3.1.7.

On the basis of its review, the staff determines that loss of material due to general pitting and crevice corrosion is an aging effect for steel elements of accessible and inaccessible areas of containments for the period of extended operation. The staff finds that applicant's inspections and tests in accordance with the ASME Section XI, Subsection IWE Program and the 10 CFR Part 50, Appendix J Program to manage loss of material due to general pitting and crevice corrosion are adequate because (1) the aging effect has been effectively monitored and managed under the programs for accessible containment steel elements, and (2) containment concrete in contact with the embedded containment liner was designed, constructed, and inspected in accordance with applicable ACI and ASTM standards, which provide for a good quality, dense, well cured, and low permeability concrete, hence corrosion for inaccessible areas is not expected to be significant. Therefore, the staff agrees that no additional plant-specific program is required.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.4. For those line items that apply to LRA Section 3.5.2.2.1.4, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

<u>Loss of Prestress due to Relaxation, Shrinkage, Creep, and Elevated Temperature</u>. The staff reviewed LRA Section 3.5.2.2.1.5 using the review procedures of SRP-LR Section 3.5.2.2.1.5.

In LRA Section 3.5.2.2.1.5, the applicant stated that loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature is a TLAA for prestressed concrete containment.

SRP-LR Section 3.5.2.2.1.5 states that loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for PWR prestressed concrete containments and BWR Mark II prestressed concrete containments is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c).

TMI-1 containment is prestressed concrete. Therefore, loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for the TMI-1 Containment is a TLAA defined in 10 CFR 54.3. The applicant's TLAA evaluation in accordance with 10 CFR 54.21(c) is discussed in LRA Section 4.7. The staff's review of the applicant's evaluation of this TLAA is documented in the SER Section 4.7.

<u>Cumulative Fatigue Damage</u>. The staff reviewed LRA Section 3.5.2.2.1.6 using the review procedures of SRP-LR Section 3.5.2.2.1.6.

In LRA Section 3.5.2.2.1.6, the applicant stated that the TLAA evaluation of metal fatigue for penetration bellows (Fuel transfer canal penetration) in accordance with 10 CFR 54.21(c) is discussed in LRA Section 4.5. Penetration sleeves and dissimilar welds are evaluated in LRA subsection 3.5.2.2.1.8.

SRP-LR Section 3.5.2.2.1.6 states that if included in the current licensing basis, fatigue analyses of suppression pool steel shells (including welded joints) and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) for all types of PWR and BWR containments and BWR vent header, vent line bellows, and downcomers are TLAAs as defined in 10 CFR 54.3.

SER Section 4.5 documents the staff's review of the applicant's TLAA evaluation of metal fatigue for penetration bellows.

Cracking due to Stress Corrosion Cracking (SCC). The staff reviewed LRA Section 3.5.2.2.1.7 using the review procedures of SRP-LR Section 3.5.2.2.1.7.

In LRA Section 3.5.2.2.1.7, the applicant stated that SCC is not an applicable aging effect for the TMI-1 containment penetration sleeves, penetration bellows, and dissimilar metal welds, since the penetration sleeves, penetration bellows, and dissimilar metal welds are not subject to an aggressive chemical environment.

SRP-LR Section 3.5.2.2.1.7 states that cracking due to SCC of stainless steel penetration sleeves, penetration bellows, and dissimilar metal welds could occur in all types of PWR and BWR containments. Cracking due to SCC could also occur in stainless steel vent line bellows for BWR containments. The existing program relies on the ASME Section XI, Subsection IWE Program and the 10 CFR Part 50, Appendix J Program to manage this aging effect. The GALL Report recommends further evaluation of additional appropriate examinations/evaluations implemented to detect these aging effects for stainless steel penetration sleeves, penetration bellows and dissimilar metal welds, and stainless steel vent line bellows.

The staff acknowledged that stainless steel must be subject to both high temperature (greater than 140 °F) and an aggressive chemical environment to be susceptible to SCC. NUREG-1833 "Technical Bases for Revision to the license Renewal Guidance Documents" states "In general, SCC very rarely occurs in austenitic stainless steels below 140 °F. Although SCC has been observed in stagnant, oxygenated borated water systems at lower temperatures than this 140 °F threshold, all of these instances have identified a significant presence of contaminants (halogens, specifically chlorides) in the failed components. With a harsh enough environment (significant contamination), SCC can occur in austenitic stainless steel at ambient temperature. However, these conditions are considered event driven, resulting from a breakdown of chemistry controls." The staff noted that the containment penetration sleeves, penetration bellows, and dissimilar metal welds are not subject to an aggressive chemical environment. On the basis of its review, the staff agrees that cracking due to SCC for the containment penetration sleeves, penetration bellows, and dissimilar metal welds is not applicable to TMI-1 since the conditions necessary for SCC, both high temperature (greater than 140 °F) and exposure to an aggressive environment, do not simultaneously exist.

Cracking due to Cyclic Loading. The staff reviewed LRA Section 3.5.2.2.1.8 using the review procedures of SRP-LR Section 3.5.2.2.1.8.

In LRA Section 3.5.2.2.1.8, the applicant stated that the ASME Section XI, Subsection IWE as described in the LRA B.2.1.24, and 10 CFR 50, Appendix J as described in the LRA B.2.1.27 are used to manage cracking due to cyclic loading of the containment penetration sleeves including the closure plates. The applicant further stated that plant operating experience has not identified cracking of penetration sleeves or the closure plates as a concern and leakage through the reactor building during pressure testing conducted in accordance with 10 CFR Part 50, Appendix J, meets or exceeds TS requirements. In addition, the applicant stated that penetration bellows are evaluated for cumulative fatigue damage in LRA Section 3.5.2.2.1.6.

SRP-LR Section 3.5.2.2.1.8 states that cracking due to cyclic loading of suppression pool steel and stainless steel shells (including welded joints) and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) could occur for all types of containments and BWR vent header, vent line bellows and downcomers. SRP-LR Section 3.5.2.2.1.8 also states that the existing program relies on the ASME Section XI, Subsection IWE Program and the 10 CFR Part 50, Appendix J Program to manage this aging effect. However, VT-3 visual inspection may not detect fine cracks. The GALL Report recommends further evaluation for detection of this aging effect.

The ASME Section XI, Subsection IWE Program and the 10 CFR Part 50, Appendix J Program are existing programs that are consistent with all elements of GALL AMP XI.S1, "ASME Section XI, Subsection IWE," and GALL AMP XI.S4, "10 CFR Part 50, Appendix J," respectively. The staff's reviews of the ASME Section XI, Subsection IWE program and the 10 CFR Part 50, Appendix J program are documented in SER Sections 3.0.3.2.19 and 3.0.3.1.7 respectively.

The staff reviewed the AMR and its associated AMPs. During the onsite review of the associated AMPs, the staff also interviewed applicant's technical personnel. The staff confirmed that TMI-1 operating experience did not identify any events related to cyclic loading induced cracking of containment components. Metal fatigue for penetration bellows is a TLAA. SER Section 4.5 documents the staff's review of the applicant's TLAA evaluation.

On the basis of its review, the staff finds that applicant's Section XI, Subsection IWE and 10 CFR Part 50, Appendix J to manage the aging effect of cracking due to cyclic loading of steel, stainless steel elements and dissimilar welds in penetration sleeves agrees with the recommendation of the GALL Report. The staff also agrees that the applicant's evaluation is acceptable since TMI-1 operating experience did not identify cracking of penetration sleeves or the closure plates as a concern.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.8. For those line items that apply to LRA Section 3.5.2.2.1.8, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Loss of Material (Scaling, Cracking, and Spalling) due to Freeze-Thaw. The staff reviewed LRA Section 3.5.2.2.1.9 using the review procedures of SRP-LR Section 3.5.2.2.1.9.

TMI-1 is located in an area in which weathering conditions are considered severe. The applicant stated in LRA Section 3.5.2.2.1.9 that the existing ASME Section XI, Subsection IWL Program is used to manage loss of material (scaling, cracking, and spalling) due to freeze-thaw of accessible containment concrete elements. For inaccessible areas, the applicant further stated that the aging effect is not significant and requires no aging management because its containment concrete structures were designed, constructed, and inspected in accordance with applicable ACI and ASTM standards, which provide for a good quality, dense, well cured, and low permeability concrete. The applicant also committed in the LRA that inaccessible concrete will be inspected if exposed for any reason, as required by the Structures Monitoring Program.

SRP-LR Section 3.5.2.2.1.9 states that loss of material (scaling, cracking, and spalling) due to freeze-thaw could occur in PWR and BWR concrete containments. The SRP-LR also states that the existing program relies on ASME Section XI, Subsection IWL to manage this aging effect. The SRP-LR further states that the GALL Report recommends further evaluation of this aging effect for plants located in moderate to severe weathering conditions.

The LRA describes the existing ASME Section XI, Subsection IWL Program as consistent with GALL AMP XI S2 "ASME Section XI, Subsection IWL." The staff's review of the ASME Section XI, Subsection IWL Program is documented in SER Section 3.0.3.1.6.

The staff reviewed the LRA. The staff confirmed that the Section XI, Subsection IWL Program is credited for aging management of the aging effect for accessible containment concrete elements. The staff also noted that the Structures Monitoring Program will include examination of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible through excavation.

The staff further found the concrete mix design addressed freeze-thaw damage potential by using low water-to-cement ratio and sufficient air content for structures subject to freezing and thawing. The staff noted that the air content of the containment concrete varied from 2.5 % to 8 %, which exceeds the GALL recommendation of 3% to 6%. However, according to ACI 201.2R "Guide to Durable Concrete," for concrete exposed to freezing and thawing, air content of 4.5 to 7.5 is recommended for severe exposure, and air content of 3.5 to 6 is recommended for moderate exposure. In addition, tolerance on air content of 1.5 % is allowed. Therefore, the staff found that the concrete is consistent with the air content recommendation of ACI 201.2R-77 for concrete resistant to freezing and thawing. In addition, the staff also noted that containment concrete has a water-to-cement ratio of 0.44 with a 5000 psi compressive strength. The staff confirmed that 0.44 water-to-cement ratio of TMI-1 containment concrete meets the recommendation of ACI 201.2R-77 for a water-to-cement ratio of less than 0.50 for a dense concrete with a low permeability.

On the basis of its review, the staff finds that loss of material (scaling, cracking, and spalling) due to freeze-thaw is not a significant aging effect for concrete elements of the containment because the absence of the significant aging effects is confirmed from the operating experience under the existing ASME Section XI, Subsection IWL Program. The staff also finds the applicant's evaluation acceptable because (1) the containment concrete is designed, constructed, and inspected in accordance with applicable ACI and ASTM standards and meets the intent of ACI 201.2R-77 as recommended by the GALL Report, and (2) the Structures Monitoring Program will include examination of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible through excavation.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.9. For those line items that apply to LRA Section 3.5.2.2.1.9 the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

<u>Cracking due to Expansion and Reaction with Aggregate, and Increase in Porosity and Permeability due to Leaching of Calcium Hydroxide</u>. The staff reviewed LRA Section 3.5.2.2.1.10 using the review procedures of SRP-LR Section 3.5.2.2.1.10.

In LRA Section 3.5.2.2.1.10, the applicant stated that the applicant's existing AMP ASME Section XI, Subsection IWL program is used to manage cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide for accessible TMI-1 Containment concrete elements.

For inaccessible areas, the applicant further evaluated that the cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide is not significant and requires no aging management because (1) TMI-1 containment concrete is designed and constructed to meet ACI and ASTM Standards and meets the intent of ACI 201.2R, and (2) aggregates were tested in accordance with ASTM Specifications C 29-60, C 40-66, C 127-59, C 128-59, and C 139-63 to confirm that the aggregates are not reactive. However, the applicant committed that inaccessible concrete will be inspected for cracking and increase in porosity and permeability if excavated for any reason, as required by the TMI-1 Structures Monitoring Program.

SRP-LR Section 3.5.2.2.1.10 states that cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide could occur in concrete elements of concrete and steel containments. SRP-LR Section 3.5.2.2.1.10 also states that the existing program relies on ASME Section XI, Subsection IWL to manage these aging effects. The LRA describes the existing ASME Section XI, Subsection IWL Program as consistent with GALL AMP XI.S2 "ASME Section XI, Subsection IWL." The staff's review of the ASME Section XI, Subsection IWL Program is documented in SER Section 3.0.3.1.6. The GALL Report recommends further evaluation if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

The staff reviewed the LRA including the AMR and the associated AMPs. During the on-site review the staff also interviewed applicant's technical personnel. From review of the associated AMPs and operating experience, the staff confirmed that these aging effects are not significant at TMI-1. As discussed above in SER Sections 3.5.2.2.1.1 and 3.5.2.2.1.9, the TMI-1 containment concrete meets the recommendations of ACI 201.2R-77 as suggested by the GALL on water-to-cement ratio, air content, and aggregate reactivity issues.

On the basis of its review, the staff finds that cracking due to expansion and reaction with aggregate, increase in porosity and permeability due to leaching of calcium hydroxide are not plausible aging effects for concrete elements of containments because (1) the containment concrete is designed, constructed, and inspected in accordance with applicable ACI and ASTM standards meets the recommendations of ACI 201.2R-77, and (2) the absence of the aging effects is confirmed under the existing ASME Section XI, Subsection IWL Program as recommended by the GALL Report. Therefore, the staff concluded that, the applicant has met the criteria of SPR-LR Section 3.5.2.2.1.10 for further evaluation.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.1.10. For those line items that apply to LRA Section 3.5.2.2.1.10, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.2.2 Safety-Related and Other Structures and Component Supports

The staff reviewed LRA Section 3.5.2.2.2 against the criteria in SRP-LR Section 3.5.2.2.2.

<u>Aging of Structures Not Covered by Structures Monitoring Program</u>. The staff reviewed LRA Section 3.5.2.2.2.1 against the criteria in SRP-LR Section 3.5.2.2.2.1.

In LRA Section 3.5.2.2.2.1, the applicant stated that the GALL structure Groups 2, 7, 8, and 9 do not exist. The Structures Monitoring Program described in the LRA is credited to manage aging effects applicable to Groups 1, 3, 4, and 5 structures. Even if the aging management review did not identify aging effects requiring management, accessible structures will be monitored through the Structures Monitoring Program. The applicant stated that aging effects not requiring management are (1) scaling, cracking, spalling and increase in porosity and permeability due to leaching of calcium hydroxide for Groups 1, 3, 4, and 5 structures, (2) loss of material and cracking due to freeze-thaw for Group 4 structures and (3) reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation for Groups 1, 3, 4, and 5 structures.

SRP-LR Section 3.5.2.2.2.1 states that the GALL Report recommends further evaluation of certain structure/aging effect combinations if they are not covered by the structures monitoring program. This includes (1) cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1-5, 7, 9 structures; (2) increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1-5, 7, 9 structures; (3) loss of material due to corrosion for Groups 1-5, 7, 8 structures; (4) loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1-3, 5, 7-9 structures; (5) cracking due to expansion and reaction with aggregates for Groups 1-5, 7-9 structures; (6) cracks and distortion due to increased stress levels from settlement for Groups 1-3, 5-9 structures; and (7) reduction in foundation strength, cracking, differential settlement due to erosion of porous concrete subfoundation for Groups 1-3, 5-9 structures. The GALL Report recommends further evaluation only for structure/aging effect combinations that are not within the structures monitoring program. In addition, SRP-LR Section 3.5.2.2.2.1 also states that lock up due to wear could occur for Lubrite® radial beam seats in BWR drywell, RPV support shoes for PWR with nozzle supports, steam generator supports, and other sliding support bearings and sliding support surfaces. The existing program relies on the Structures Monitoring Program or the ASME Section XI, Subsection IWF Program to manage this aging effect. The GALL Report recommends further evaluation only for structure/aging effect combinations that are not within the ISI (IWF) or structures monitoring program.

The staff noted the GALL structure Groups 2, 7, 8, and 9 do not exist. The staff further noted that the applicant's Structures Monitoring Program is credited for aging management of these effects/mechanisms for the affected concrete structures and structural components even if the aging management review did not identify aging effects requiring management. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21.

Additional reviews of specific aging effects/mechanisms are discussed below.

(1) Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling) Due to Corrosion of Embedded Steel for Groups 1-5, 7, and 9 Structures

The staff's reviews for cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for inaccessible concrete areas of containments, below-grade inaccessible concrete areas of Groups 1, 3, and 5 structures, and below-grade inaccessible concrete areas of Group 6 Structures are documented in SER Sections 3.5.2.2.1.1, 3.5.2.2.2.2.4, and 3.5.2.2.2.4.1 respectively. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. The staff confirmed that Groups 1 and 3-5, structures (structure Groups 2, 7, 8, and 9 do not exist at TMI-1) subject to this AMR are all in-scope of the Structures Monitoring Program.

Therefore, the staff agrees that the criteria of SRP-LR Section 3.5.2.2.2.1 have been met, and no further evaluation is required.

(2) Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling) Due to Aggressive Chemical Attack for Groups 1-5, 7, and 9 Structures

The staff's reviews for increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack for inaccessible concrete areas of containments, below-grade inaccessible concrete areas of Groups 1, 3, and 5 structures, and below-grade inaccessible concrete areas of Groups 6 Structures are documented in SER Sections 3.5.2.2.1.1, 3.5.2.2.2.2.4, and 3.5.2.2.2.4.1, respectively. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. The staff confirmed that Groups 1 and 3-5, structures (structure Groups 2, 7, 8, and 9 do not exist at TMI-1) subject to this AMR are all in-scope of the Structures Monitoring Program. Therefore, the staff agrees that the criteria of SRP-LR Section 3.5.2.2.2.1 have been met, and no further evaluation is required.

(3) Loss of Material Due to Corrosion for Groups 1-5, 7, and 8 Structures

The staff's review for loss of material due to general, pitting and crevice corrosion for steel elements of containments is documented in SER Section 3.5.2.2.1.4. The staff's review of the Structures Monitoring Program is documented in SER Sections 3.0.3.2.21. The staff finds that Groups 1, and 3-5 structures (structure Groups 2, 7, 8, and 9 do not exist at TMI-1) subject to this AMR are all in-scope of the Structures Monitoring Program. Therefore, the staff agrees that the criteria of SRP-LR Section 3.5.2.2.2.1 have been met, and no further evaluation is required.

(4) Loss of Material (Spalling, Scaling) and Cracking Due to Freeze-Thaw for Groups 1-3, 5, and 7-9 Structures

The staff's reviews for loss of material (spalling, scaling) and cracking due to freeze-thaw for concrete containments, below-grade inaccessible concrete areas of Groups 1, 3, and 5 structures, and below-grade inaccessible concrete areas of Groups 6 Structures are documented in SER Sections 3.5.2.2.1.9, 3.5.2.2.2.2.1 and 3.5.2.2.2.4.2, respectively. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. The staff found that this is not an applicable aging effect for Group 4 structures because Group 4 structures are inside the Reactor Building and protected from repeated freeze-thaw. The staff confirmed that Groups 1, 3 and 5 structures (structure Groups 2, 7, 8, and 9 do not exist at TMI-1) subject to this AMR are all in-scope of the Structures Monitoring Program. Therefore, the staff agrees that the criteria of SRP-LR Section 3.5.2.2.2.1 have been met, and no further evaluation is required.

(5) Cracking Due to Expansion and Reaction with Aggregates for Groups 1-5 and 7-9 Structures

The staff's reviews for cracking due to expansion and reaction with aggregates for concrete elements of containments, below-grade inaccessible areas of Groups 1, and 3-5 structures, and below–grade inaccessible reinforced concrete areas of Groups 6 structures are documented in SER Sections 3.5.2.2.1.10, 3.5.2.2.2.2.2, and 3.5.2.2.2.4.3 respectively. The staff's review of the Structures Monitoring Program is documented in

SER Section 3.0.3.2.21. The staff finds that Groups 1, and 3-5 structures (structure Groups 2, 7, 8, and 9 do not exist at TMI-1) subject to this AMR are all in-scope of the Structures Monitoring Program. Therefore, the staff agrees that the criteria of SRP-LR Section 3.5.2.2.2.1 have been met, and no further evaluation is required.

(6) Cracks and Distortion Due to Increased Stress Levels from Settlement for Groups 1-3 and 5-9 Structures

The staff's reviews for cracks and distortion due to increased stress levels from settlement for containment and below-grade inaccessible areas of Groups 1, and 3, and 5 structures are documented in SER Sections 3.5.2.2.1.2 and 3.5.2.2.2.2.3, respectively. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. The staff finds that Groups 1, 3, 5, and 6 structures (structure Groups 2, 7, 8, and 9 do not exist at TMI-1) subject to this AMR are all in-scope of the Structures Monitoring Program. Therefore, the staff agrees that the criteria of SRP-LR Section 3.5.2.2.2.1 have been met, and no further evaluation is required.

(7) Reduction in Foundation Strength, Cracking, and Differential Settlement Due to Erosion of Porous Concrete Subfoundation for Groups 1-3 and 5-9 Structures

The staff's reviews for reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation for containment and below-grade inaccessible areas of Groups 1, and 3, and 5 structures are documented in SER Sections 3.5.2.2.1.2 and 3.5.2.2.2.2.3, respectively. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. The staff determined through reviews that reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation for Groups 1, 3, 5, and 6 structures are not plausible aging effects due to the absence of porous concrete subfoundation. The staff noted that even if the aging management review did not identify aging effects requiring management, accessible structures will be monitored through the Structures Monitoring Program. Therefore, the staff agrees that the criteria of SRP-LR Section 3.5.2.2.2.1 have been met, and no further evaluation is required

(8) Lockup Due to Wear for Lubrite® Radial Beam Seats in BWR Drywell and Other Sliding Support Surfaces

SRP-LR Section 3.5.2.2.2.1 also states that lockup due to wear could occur for Lubrite® radial beam seats in BWR drywell, RPV support shoes for PWR with nozzle supports, steam generator supports, and other sliding support bearings and sliding support surfaces. The existing program relies on the Structures Monitoring Program and ASME Section XI, Subsection IWF to manage this aging effect. The GALL Report recommends further evaluation only for structure/aging effect combinations that are not within the ISI (IWF) or Structures Monitoring Program.

In LRA Section 3.5.2.2.2.1, the applicant stated that RPV support shoes and steam generator supports do not include sliding surfaces. The Structures Monitoring Program and the ASME Section XI, Subsection IWF program are used to manage lock-up due to wear for the sliding surfaces provided for supports for Main Steam relief valves, heat exchanger supports, and floor beam seats.

On the basis of its review, the staff concludes that no further evaluation is required for lock up due to wear because the structure/aging effect combinations are within the applicant's Structures Monitoring Program and ASME Section XI, Subsection IWF program.

On the basis of its review, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.1. For those line items that apply to LRA Section 3.5.2.2.2.1, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Aging Management of Inaccessible Areas. The staff reviewed LRA Section 3.5.2.2.2.2 against the criteria in SRP-LR Section 3.5.2.2.2.2.

(1) TMI-1 is located in an area in which weathering conditions are considered severe. The applicant stated in LRA Section 3.5.2.2.2.2.1 that loss of material (scaling, cracking, and spalling) due to freeze-thaw in below-grade inaccessible concrete areas for structure Groups 1, 3, and 5 (structure Groups 2, 7, 8, and 9 do not exist at TMI-1) is not significant and requires no aging management because concrete structures at TMI-1 were designed, constructed, and inspected in accordance with applicable ACI and ASTM standards, which provide for a good quality, dense, well cured, and low permeability concrete. The TMI-1 concrete mix design addressed freeze-thaw damage potential by using entrained air and aggregate soundness for structures subject to freezing and thawing. However, the applicant committed that inaccessible concrete will be inspected if exposed for any reason, as required by TMI-1 Structures Monitoring Program.

The staff reviewed LRA Section 3.5.2.2.2.2.1 against the criteria in SRP-LR Section 3.5.2.2.2.2.1, which states that loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas of these Groups of structures for plants located in moderate to severe weathering conditions.

The staff reviewed the LRA. The staff noted that the Structures Monitoring Program will include examination of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible through excavation. The staff further noted the TMI-1 concrete mix design addressed freeze-thaw damage potential by using sufficient air content for structures subject to freezing and thawing. The staff found that the air content of TMI-1 containment concrete varied from 2.5% to 8%, which exceeds the GALL recommendation of 3% to 6%. However, according to ACI 201.2R "Guide to Durable Concrete," for concrete exposed to freezing and thawing, air content of 3.5 to 7.5 is recommended. In addition, tolerance on air content of 1.5% is allowed. Therefore, the staff found that the TMI-1 concrete is consistent with the air content recommendations of ACI 201.2R-77 for concrete resistant to freezing and thawing.

On the basis of its review, the staff agrees that for TMI-1, loss of material (scaling, cracking, and spalling) due to freeze-thaw is not a significant aging effect for inaccessible areas for structure Groups 1, 3, and 5 because the absence of the significant aging effects is confirmed from the operating experience under the existing

Structures Monitoring Program. The staff also finds the applicant's evaluation acceptable because (1) the TMI-1 concrete mix design addressed freeze-thaw damage potential by using entrained air and aggregate soundness for structures subject to freezing and thawing in accordance with applicable ACI and ASTM which meet the intent of ACI 201.2R-77 for moderate to severe exposure as recommended by the GALL, and (2) the Structures Monitoring Program will include examination of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible through excavation.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.2.1. For those line items that apply to LRA Section 3.5.2.2.2.2.1, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) In LRA Table 3.5.1, Item 3.5.1-27, the applicant stated that the existing Structures Monitoring Program is used to manage cracking of interior/exterior concrete due to expansion and reaction with aggregate for accessible and inaccessible areas regardless of aging mechanism. For below-grade inaccessible concrete areas, the applicant further evaluated in LRA Section 3.5.2.2.2.2.2 that the cracking due to expansion and reaction with aggregate is not significant and requires no aging management because (1) The containment concrete is designed and constructed to meet ACI and ASTM Standards and meets the intent of ACI 201.2R, and (2) aggregates were tested in accordance with ASTM Specifications C 29-60, C 40-66, C 127-59, C 128-59, and C 139-63 to confirm that the aggregates meet ACI requirements. However, the applicant committed that inaccessible concrete will be inspected for cracking if excavated for any reason, as required by the Structures Monitoring Program.

The staff reviewed LRA Section 3.5.2.2.2.2.2 against the criteria in SRP-LR Section 3.5.2.2.2.2.2, which states that cracking due to expansion and reaction with aggregates could occur in below-grade inaccessible concrete areas for Groups 1-5 and 7-9 structures. The GALL Report recommends further evaluation of inaccessible areas of these Groups of structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

The staff reviewed the LRA including the AMR and the associated Structures Monitoring Program. The staff noted from NUREG-1611 "Aging Management of Nuclear Power Plant Containment for License Renewal" that reaction with aggregates in inaccessible areas would also occur in accessible areas because aggregates were used in construction of both accessible and inaccessible areas. The existing Structures Monitoring Program requires periodic examination of accessible concrete surfaces and inspection of inaccessible concrete areas for cracking if excavated for any reason.

On the basis of its review, the staff agrees that cracking due to expansion and reaction with aggregate is not a significant aging effect for concrete elements because the absence of the significant aging effects is confirmed from the operating experience under the existing Structures Monitoring Program. The staff also finds the applicant's evaluation acceptable because (1) the aggregates were tested in accordance with ASTM Specifications, (2) the Structures Monitoring Program will detect the aging effects in the accessible areas, which will trigger additional evaluation of accessible and inaccessible areas, and (3) the inaccessible areas will be examined by the Structures Monitoring Program when the areas are available for inspection due to future excavation.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.2.2. For those line items that apply to LRA Section 3.5.2.2.2.2.2, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(3) The applicant stated in the LRA Section 3.5.2.2.2.2.3 that (1) the foundation of structure Groups 1, 4, and 5 is founded on bedrock and no settlement has been experienced, Group 3 structures whose foundations are founded on soil are subject to cracks and distortion due to increased stress levels from settlement and in scope of the Structures Monitoring Program, (2) the foundation is not constructed of porous concrete, and (3) the plants design does not employ a de-watering system for control of settlement.

The staff reviewed LRA Section 3.5.2.2.2.2.3 against the criteria in SRP-LR Section 3.5.2.2.2.2.3, which states that cracks and distortion due to increased stress levels from settlement and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. LRA Section 3.5.2.2.2.2.3 states that the existing program relies on the Structures Monitoring Program to manage these aging effects. The TMI-1 Structures Monitoring Program described in LRA Section B.2.1.28 is an existing program that is consistent with all elements of the Structures Monitoring Program in the GALL, when the enhancements are incorporated in the program. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.21. SRP-LR Section 3.5.2.2.2.2.3 further states that the GALL Report recommends no further evaluation if this activity is within the scope of the applicant's structures monitoring program.

The staff has reviewed the LRA including the AMR and its associated AMP. The staff confirmed that the TMI-1 base foundation is not constructed of porous concrete below grade. The staff further confirmed that the associated AMP Structures Monitoring Program is credited for aging management of these effects for the affected concrete structures and structural components, and will include examination of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible during excavation.

On the basis of its review, the staff finds that cracks and distortion due to increased stress levels from settlement; reduction of foundation strength, cracking and differential settlement due to erosion of porous concrete subfoundations are not plausible aging effects in below-grade inaccessible concrete areas of Groups 1 and 5 structures (structure Groups 2, 7, 8, and 9 do not exist at TMI-1) because conditions necessary for the aging effects, such as a soil environment as described in associated AMR line items of the GALL Report, Volume 2, do not exist. The staff also finds that these aging effects could affect TMI-1 concrete area of Group 3 structures whose foundation is founded on soil. However, the applicant's Structures Monitoring Program is credited for aging management of these effects for the affected concrete structures and structural components for structure Group 3. Therefore, the staff finds that no further evaluation is required.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.2.3. For those line items that apply to LRA Section 3.5.2.2.2.2.3, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21 (a)(3).

(4) The applicant stated that inaccessible below-grade reinforced concrete for Group 1, 3, and 5 structures is not subject to an aggressive environment because historical chemistry results of groundwater water samples have confirmed that groundwater is non-aggressive. Groundwater water is periodically monitored as required by the Structures Monitoring Program. The applicant committed to perform examinations of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible through excavation.

The staff reviewed LRA Section 3.5.2.2.2.2.4 against the criteria in SRP-LR Section 3.5.2.2.2.2.4, which states that increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The GALL Report recommends further evaluation of plant specific programs to manage the aging effects for inaccessible areas if the environment is aggressive.

To ensure non-aggressive groundwater chemistries, the GALL Report suggests the performance of periodic groundwater inspection for chlorides, sulfates, and pH. The staff noted that the applicant's groundwater inspection program is performed by the applicant's Structures Monitoring Program described in LRA Section B.2.28. The staff's review of the applicant's Structures Monitoring Program, including periodic monitoring of groundwater, is documented in SER Section 3.0.3.2.21.

The staff reviewed the LRA including the AMR and its associated AMP. The staff noted that the sampling results from 1996 presented in the LRA, which indicated a groundwater pH range of 6.1-6.7, a chloride range of 3.5-210 ppm, and a sulfate range of 14.1-410 ppm. In RAI B.2.1.28-1, dated October 7, 2008, the staff requested that the applicant provide additional information concerning the frequency of periodic sampling and the results for the last two sampling of groundwater.

In its response to the RAI dated October 30, 2008, the applicant stated that the groundwater sampling for pH, chloride, and sulfate concentrations will be performed every 5 years during the period of extended operation. The applicant also demonstrated the last two groundwater samplings include one sample taken in 2007 and three taken in 2005, which showed a pH range of 7.4-7.8, a chloride range of 42.4-65.5 ppm, and a sulfate range of 27-53.3. The staff confirmed that the below-grade environment at TMI-1 is non-aggressive (pH greater than 5.5, Chlorides less than 500 ppm, and Sulfates less than 1500 ppm). The staff's concern described in RAI B.2.1.28-1 is resolved.

On the basis of its review, the staff finds that the AMR results consistent with the GALL Report. The staff agrees that a plant specific aging management program is not required for below-grade inaccessible concrete areas of the TMI-1 Group 1, 3, and 5 (structure Groups 2, 7, 8, and 9 do not exist) structures to manage aging effects of increases in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel because (1) the groundwater water environment is confirmed not aggressive to concrete; (2) the inspection frequency of groundwater chemistries as required by the Structures Monitoring Program agrees with the recommendation of the GALL; and (3) the applicant committed to perform examinations of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible through excavation.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.2.4. For those line items that apply to LRA Section 3.5.2.2.2.2.4, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(5) In LRA Section 3.5.2.2.2.2.5, the applicant stated that the cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide in below-grade inaccessible concrete areas requires no aging management because (1) the concrete is designed and constructed to meet ACI and ASTM Standards and meets the intent of ACI 201.2R, and (2) the aggregates were tested in accordance with ASTM Specifications C 29-60, C 40-66, C 127-59, C 128-59, and C 139-63 to confirm that the aggregates meet ACI requirements.

The staff reviewed LRA Section 3.5.2.2.2.2.5 against the criteria in SRP-LR Section 3.5.2.2.2.2.5, which states that increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. SRP-LR states that the GALL Report Section 3.5.2.2.2.2.5 recommends further evaluation of this aging effect for inaccessible areas of these Groups of structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

The GALL Report states that an aging management program is not necessary for inaccessible areas, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77.

The staff reviewed the LRA. The staff noted that concrete structures are designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. The Portland cement conforms to ASTM C-150, Type II, modified for low heat of hydration. Neither calcium chloride nor any admixtures containing calcium chloride or other chlorides, sulfides, or nitrates were used.

The staff also noted that leaching of calcium hydroxide from reinforced concrete becomes significant only if the concrete is exposed to flowing water; however, the TMI-1 concrete components below grade for Groups 1, 3, 4, and 5 structures (structure Groups 2, 7, 8, and 9 do not exist at TMI-1) are not exposed to flowing water.

On the basis of its review, the staff agrees that increase in porosity and permeability due to leaching of calcium hydroxide are not applicable aging effects for concrete elements of Groups 1, 3, 4, and 5 structures (structure Groups 2, 7, 8, and 9 do not exist at TMI-1) because the concrete components below grade are not exposed to flowing water.

Therefore, managing the effect of increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide are not required for concrete in inaccessible areas.

Reduction of Strength and Modulus of Concrete Structures due to Elevated Temperature. The staff reviewed LRA Section 3.5.2.2.2.3 against the criteria in SRP-LR Section 3.5.2.2.2.3.

The applicant stated in LRA Section 3.5.2.2.2.3 that Group 1, 3-5 concrete structures are maintained below the 150 °F threshold for general areas and under 200 °F for local areas.

SRP-LR Section 3.5.2.2.2.3 states that reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR Group 1-5 concrete structures. For any concrete elements that exceed specified temperature limits, further evaluations are recommended. SRP-LR Section 3.5.2.2.2.3 also states the GALL Report recommends further evaluation of a plant-specific program if any portion of the safety-related and other concrete structures exceeds specified temperature limits, i.e., general area temperature greater than 66 °C (150 °F) and local area temperature greater than 93 °C (200 °F).

The staff reviewed the LRA and found that no portion of the in-scope concrete structures and concrete at TMI-1 exceeds specified temperature limits, which are 150 °F for general area and 200 °F for local area. Therefore, this aging effect is not applicable to TMI-1.

On the basis of its review, the staff finds that reduction of strength and modulus of concrete due to elevated temperatures are not applicable aging effects to TMI-1 because the conditions necessary for the aging effects, elevated temperatures, do not exist. Therefore, the staff finds that no further evaluation is required.

Aging Management of Inaccessible Areas for Group 6 Structures. The staff reviewed LRA Section 3.5.2.2.2.4 against the criteria in SRP-LR Section 3.5.2.2.2.4.

SRP-LR Section 3.5.2.2.2.4 states that the GALL Report recommends further evaluation for inaccessible areas of certain Group 6 structure/aging effect combinations as identified below, whether or not they are covered by inspections in accordance with the GALL Report, Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance.

The staff's review and evaluation of aging management of inaccessible areas for Group 6 structures are addressed as follows.

(1) LRA Section 3.5.2.2.2.4.1 states that for inaccessible below-grade reinforced concrete for Group 6 structures, a plant specific aging management program is not required to manage the aging effects of increase in porosity and permeability, cracking, loss of material (spalling, scaling)/aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel because the environment is not aggressive, which is confirmed by the historical groundwater test results. A representative sample of below-grade concrete will be inspected, if excavated for any reason, and periodic groundwater monitoring will be done as required by the Structures Monitoring Program.

    The staff reviewed LRA Section 3.5.2.2.2.4.1 against the criteria in SRP-LR Section 3.5.2.2.2.4.1, which states that increase in porosity and permeability, cracking, loss of material (spalling, scaling)/aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel could occur in below-grade inaccessible concrete areas of Group 6 structures. The GALL Report recommends further evaluation of plants-specific programs to manage these aging effects in inaccessible areas if the environment is aggressive.

The staff has reviewed the LRA including the AMR and associated AMP. The staff confirmed that the containment concrete structures are designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. From inspection results, the staff also validated that the groundwater chemistry at TMI-1 is not aggressive. The staff noted that the applicant's groundwater inspections are performed under the applicant's Structures Monitoring Program. The staff's review of the Structures Monitoring Program including periodic monitoring of groundwater is documented in SER Section 3.0.3.2.21.

On the basis of its review, the staff finds that the Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/aggressive chemical attack; and cracking, loss of bond, and loss of material (spalling, scaling)/corrosion of embedded steel could occur in below-grade inaccessible concrete areas of Group 6 structures are not plausible aging effects because (1) the inspections of groundwater and raw water chemistries confirm that the environment is not aggressive; (2) the inspection frequency of groundwater chemistries as required by the Structures Monitoring Program agrees with the recommendation of the GALL Report; and (3) the applicant committed to perform examinations of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible through excavation, therefore, the staff finds that no further evaluation is required.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.4.1. For those line items that apply to LRA Section 3.5.2.2.2.4.1 the staff determined that the that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) TMI-1 is located in an area in which weathering conditions are considered severe. For below-grade inaccessible concrete areas for Structure Group 6, the applicant stated in LRA Section 3.5.2.2.2.4.2 that the loss of material (scaling, cracking, and spalling) due to freeze-thaw is not significant and requires no aging management because concrete structures at TMI-1 were designed, constructed, and inspected in accordance with applicable ACI and ASTM standards, which provide for a good quality, dense, well cured, and low permeability concrete. The TMI-1 concrete mix design addressed freeze-thaw damage potential by using entrained air and aggregate soundness for structures subject to freezing and thawing. However, the applicant committed to inspect inaccessible concrete if exposed for any reason, as in accordance with the Structures Monitoring Program.

The staff reviewed LRA Section 3.5.2.2.2.4.2 against the criteria in SRP-LR Section 3.5.2.2.2.4.2, which states that loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Group 6 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas for plants located in moderate to severe weathering conditions.

The staff noted that the applicant's Structures Monitoring Program, which requires periodic visual inspection, will be used to manage loss of material (spalling, scaling) and cracking due to freeze-thaw in accessible areas of water-control structures (Group 6 structures.) The staff also noted that the Structures Monitoring Program will include examination of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible during excavation. In NUREG-1611, the staff notes that any freeze-thaw degradation would initially appear in the exposed concrete structure.

The staff further found the concrete mix design addressed freeze-thaw damage potential by using sufficient air content for structures subject to freezing and thawing. The staff noted that the air content of containment concrete varied from 2.5% to 8%, which exceeds the GALL recommendation of 3% to 6%. However, according to ACI 201.2R "Guide to Durable Concrete," for concrete exposed to freezing and thawing, air content of 3.5 to 7.5 is recommended. In addition, tolerance on air content of 1.5% is allowed. Therefore, the staff found that the TMI-1 concrete is consistent with the air contents recommendation of ACI 201.2R-77 for concrete resistant to freezing and thawing.

On the basis of its review, the staff agrees that loss of material (scaling, cracking, and spalling) due to freeze-thaw is not a significant aging effect for below-grade inaccessible concrete areas of Group 6 structures because the absence of significant aging effects is confirmed from the operating experience under the existing Structures Monitoring Program. The staff also finds the applicant's evaluation acceptable because (1) the TMI-1 concrete mix design addressed freeze-thaw damage potential by using entrained air and aggregate soundness for structures subject to freezing and thawing in accordance with applicable ACI and ASTM standards and meets the intent of ACI 201.2R-77 for moderate to severe exposure as recommended in the GALL Report; (2) the Structures Monitoring Program will include examination of the accessible concrete structures for age-related degradation; and (3) the applicant will examine the inaccessible areas during any future excavations in accordance with the provisions of the applicant's Structures Monitoring Program.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.4.2. For those line items that apply to LRA Section 3.5.2.2.2.4.2, the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(3) In LRA Section 3.5.2.2.2.4.3, the applicant stated that the Structures Monitoring Program will be used to manage cracking due to expansion and reaction with aggregate, and increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide of reinforced concrete in accessible areas of water-control structures (Group 6 structures). The applicant evaluated these aging effects, stating that they are not significant in below-grade inaccessible reinforced concrete areas of Group 6 structures and requires no aging management because (1) the concrete is designed and constructed to meet ACI and ASTM Standards and meets the intent of ACI 201.2R, and (2) the aggregates were tested in accordance with ASTM Specifications C 29-60, C 40-66, C 127-59, C 128-59, and C 139-63 to confirm that the aggregates meet ACI requirements. However, the applicant has committed to inspect the inaccessible

concrete structures for cracking and increase in porosity and permeability if excavated for any reason, in accordance with the Structures Monitoring Program.

The staff reviewed LRA Section 3.5.2.2.2.4.3 against the criteria in SRP-LR Section 3.5.2.2.2.4.3, which states that cracking due to expansion and reaction with aggregates and increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide could occur in below-grade inaccessible reinforced concrete areas of Group 6 structures. The GALL Report recommends further evaluation of inaccessible areas if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

The staff reviewed the LRA including the AMR and the associated AMP Structure Monitoring Program. In NUREG-1611, the staff notes that reaction with aggregates in inaccessible areas would also occur in accessible areas because the same aggregates were used in construction of both accessible and inaccessible areas. The existing Structure Monitoring Program requires periodic examination of accessible concrete surfaces and inspection of inaccessible concrete areas for cracking if excavated for any reason.

On the basis of its review, the staff agrees that cracking due to expansion and reaction with aggregate is not a significant aging effect for in below-grade inaccessible reinforced concrete areas of Group 6 structures because the absence of the significant aging effects is confirmed from the operating experience under the existing Structure Monitoring Program. The staff also finds that the applicant's evaluation acceptable because (1) the aggregates were tested in accordance with ASTM Specifications, and (2) the Structures Monitoring Program includes periodic examination of accessible concrete surfaces, and (3) examination of the exposed concrete areas when a below-grade concrete component becomes accessible through excavation.

The GALL Report states that an aging management program is not necessary for inaccessible areas, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77. The staff noted that the TMI-1 concrete structures are designed in accordance with ACI 318-63 and constructed in accordance with ACI 301-66. The Portland cement conforms to ASTM C-150, Type II, modified for low heat of hydration. Neither calcium chloride nor any admixtures containing calcium chloride or other chlorides, sulfides, or nitrates were used. The staff also noted from the AMR results in LRA Tables 3.5.2-6 "Dike/Flood Control System" and 3.5.2-8 "Intake Screen and Pump House" that the below-grade inaccessible reinforced concrete areas of Group 6 structures are not exposed to flowing water.

On the basis of its review, the staff agrees that increase in porosity and permeability due to leaching of calcium hydroxide is not a significant aging effect for below-grade inaccessible reinforced concrete areas of Group 6 structures because the concrete components below grade are not exposed to flowing water. Therefore, managing the effect of increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide are not required for concrete in inaccessible areas.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.4.3. For those line items that apply to LRA Section 3.5.2.2.2.4.3 the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Cracking due to Stress Corrosion Cracking and Loss of Material due to Pitting and Crevice Corrosion. The staff reviewed LRA Section 3.5.2.2.2.5 using the review procedures of SRP-LR Section 3.5.3.2.2.5.

In LRA Section 3.5.2.2.2.5, the applicant stated that it does not have Group 7 and 8 stainless steel tank liners.

SRP-LR Section 3.5.2.2.2.5 states that cracking due to stress corrosion cracking and loss of material due to pitting and crevice corrosion could occur for Group 7 and 8 stainless steel tank liners exposed to standing water. The GALL Report recommends further evaluation of plant-specific programs to manage these aging effects.

The staff's review of the LRA indicated that TMI-1 does not have Group 7 and 8 stainless steel tank liners. Therefore, this AMR is not applicable to TMI-1.

On the basis of its review, the staff finds that cracking due to stress corrosion cracking and loss of material due to pitting and crevice corrosion that could occur for Group 7 and 8 stainless steel tank liners exposed to standing water are not applicable since there are no Group 7 and 8 stainless steel tank liners at TMI-1.

Aging of Supports Not Covered by Structures Monitoring Program. The staff reviewed LRA Section 3.5.2.2.2.6 using the review procedures of SRP-LR Section 3.5.3.2.2.6.

In Items 3.5.1-39, 3.5.1-40 and 3.5.1-41 of LRA Table 3.5.1, the applicant stated that the Structures Monitoring Program is used to manage (1) loss of material due to general and pitting corrosion for support members; welds; bolted connections; support anchorage to building structure, (2) reduction in concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging mechanisms in building concrete at locations of expansion and grouted anchors; grout pads for support base plates, and (3) reduction or loss of isolation function/radiation hardening, temperature, humidity, sustained vibratory loading for vibration isolation elements. Therefore, the applicant provided no further evaluation.

SRP-LR Section 3.5.2.2.2.6 states that the GALL Report recommends further evaluation of certain component support/aging effect combinations if they are not covered by the structures monitoring program. This includes (1) loss of material due to general and pitting corrosion, for Groups B2-B5 supports; (2) reduction in concrete anchor capacity due to degradation of the surrounding concrete, for Groups B1-B5 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements, for Group B4 supports. Further evaluation is necessary only for structure/aging effect combinations not covered by the structures monitoring program.

The staff has reviewed the LRA. The staff confirmed that the component support/aging effect combinations of (1) loss of material due to general and pitting corrosion, for Groups B2-B5 supports; (2) reduction in concrete anchor capacity due to degradation of the surrounding concrete, for Groups B1-B5 supports; and (3) reduction/loss of isolation function due to degradation of vibration isolation elements, for Group B4 supports; are all covered by the

Structures Monitoring Program. Therefore, the staff determined that no further evaluation is required.

Based on a review of the programs identified above, the staff concluded that the applicant has met the criteria of SRP-LR Section 3.5.2.2.2.6. For those line items that apply to LRA Section 3.5.2.2.2.6 the staff determined that the LRA is consistent with the GALL Report and the applicant has demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Cumulative Fatigue Damage due to Cyclic Loading. The staff reviewed LRA Section 3.5.2.2.2.7 using the review procedures of SRP-LR Section 3.5.3.2.2.7.

In LRA Section 3.5.2.2.2.7, the applicant stated that TMI-1 current licensing basis contains no fatigue analysis for component supports members, anchor bolts, and welds of Groups B1.1, B1.2, and B1.3 component supports.

SRP-LR Section 3.5.2.2.2.7 states that fatigue of component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c).

The staff has reviewed the LRA Section 3.5.2.2.2.7. The staff noted that no fatigue analyses were identified as TLAAs because there is no CLB fatigue analysis for component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3. Therefore, cumulative fatigue damage due to cyclic loading for Groups B1.1, B1.2, and B1.3 component supports is not a TLAA as defined in 10 CFR 54.3.

3.5.2.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA program.

3.5.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.5.2-1 through 3.5.2-20, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.5.2-1 through 3.5.2-20, the applicant indicated, via Notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. Specifically, Note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant had demonstrated that the aging effects will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.5.2.3.1 Structures and Component Supports – Air Intake Structure – Summary of Aging Management Evaluation – LRA Table 3.5.2-1

The staff reviewed LRA Table 3.5.2-1, which summarizes the results of AMR evaluations for the air intake structures component groups.

In LRA Table 3.5.2-1, the applicant identified 65 unique component/material/environment/aging effect/AMP groups for the Air Intake Structures. Forty three have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to LRA Table 1 and the GALL Report Volume II line items are appropriate.

For ten component types, the applicant proposed to manage reinforced concrete material, aging effect increase in porosity and permeability, loss of strength/leaching of calcium hydroxide, and cracking, loss of bond, and loss of material by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note G. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of strength/leaching of calcium hydroxide in each case. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For six component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 2, states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For six component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Air Intake Structures not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.2 Structures and Component Supports – Auxiliary Building – Summary of Aging Management Evaluation – LRA Table 3.5.2-2

The staff reviewed LRA Table 3.5.2-2, which summarizes the results of AMR evaluations for the auxiliary building component groups.

In LRA Table 3.5.2-2, the applicant identified 113 unique component/material/environment/aging effect/AMP groups for the Auxiliary Building. Ninety-eight have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For six component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 3, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling/scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For eight component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "The aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every 5 years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Auxiliary Building not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.3 Structures and Component Supports – Circulating Water Pump House – Summary of Aging Management Evaluation – LRA Table 3.5.2-3

The staff reviewed LRA Table 3.5.2-3, which summarizes the results of AMR evaluations for the circulating water pump house component groups.

In LRA Table 3.5.2-3, the applicant identified 71 unique component/material/environment/aging effect/AMP groups for the Circulating Water Pump House. Fifty-six have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For six component types, the applicant proposed to manage reinforced concrete material, aging effect increase in porosity and permeability, loss of strength/leaching of calcium hydroxide, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note G. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of strength/leaching of calcium hydroxide. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For three component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 2, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling/scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed to manage reinforced concrete material, aging effect cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 3, which states "The aging effects/mechanisms of above grade exterior concrete in a water-flowing environment include cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel. These aging effects/mechanisms are managed by the Structures Monitoring Program." The staff finds that the credited AMP is appropriate because the Structures Monitoring Program requires visual inspections on a periodic basis to manage cracking, loss of bond and loss of material due to corrosion of embedded steel. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For three component types, the applicant proposes no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "The aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Circulating Water Pump House not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.4 Structures and Component Supports – Control Building – Summary of Aging Management Evaluation – LRA Table 3.5.2-4

The staff reviewed LRA Table 3.5.2-4, which summarizes the results of AMR evaluations for the control building component groups.

In LRA Table 3.5.2-4, the applicant identified 75 unique component/material/environment/aging effect/AMP groups for the Control Building. Fifty-nine have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For six component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 3, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling/scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For nine component types, the applicant proposed no aging management program to manage GALL Item III.A1-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "The aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Control Building not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.5 Structures and Component Supports – Diesel Generator Building – Summary of Aging Management Evaluation – LRA Table 3.5.2-5

The staff reviewed LRA Table 3.5.2-5, which summarizes the results of AMR evaluations for the diesel generator building component groups.

In LRA Table 3.5.2-5, the applicant identified 59 unique component/material/environment/aging effect/AMP groups for the Diesel Generator Building. Fifty-six have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For one component type, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 2, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling/scaling) and cracking due to freeze-thaw. Since the applicant has committed to appropriate aging management programs for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Diesel Generator Building not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.6 Structures and Component Supports – Dike/Flood Control System – Summary of Aging Management Evaluation – LRA Table 3.5.2-6

The staff reviewed LRA Table 3.5.2-6, which summarizes the results of AMR evaluations for the dike/flood control system component groups.

In LRA Table 3.5.2-6, the applicant identified 39 unique component/material/environment/aging effect/AMP groups for the Dike/Flood Control System. Thirty-three have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For two component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 3, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling/scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed to manage reinforced concrete material, aging effect cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 4, which states "the aging effects/mechanisms of above grade exterior concrete in a water-flowing environment include cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel. These aging effects/mechanisms are managed by the Structures Monitoring Program." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of bond and loss of material (spalling, scaling) due to corrosion of embedded steel. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed no aging management program to manage GALL Item III.A6-3 (reinforced concrete material, item 3.5.1-34), aging effect none. These line items reference Note I and plant-specific Note 2, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Dike/Flood Control System not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.7 Structures and Component Supports – Fuel Handling Building – Summary of Aging Management Evaluation – LRA Table 3.5.2-7

The staff reviewed LRA Table 3.5.2-7, which summarizes the results of AMR evaluations for the fuel handling building component groups.

In LRA Table 3.5.2-7, the applicant identified 107 unique component/material/environment/aging effect/AMP groups for the Fuel Handling Building. Ninety have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For six component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 4, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to appropriate aging management programs for the period of extended operation, the staff finds these AMR results to be acceptable.

For eight component types, the applicant proposes no aging management program to manage GALL Item III.A5-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed no aging management program to manage GALL Item III.A5-13 (stainless steel fuel pool liner material, item 3.5.1-46), aging effect none. These line items reference Note I and plant-specific Note 3, which states "Stress corrosion cracking is not applicable since the spent fuel pool temperature is less than 140 °F." The staff reviewed the applicant's basis documents and the UFSAR, and found the spent fuel pool temperature is less than 140 °F. Therefore, stress corrosion cracking is not applicable. For loss of material/pitting and crevice corrosion, the applicant is using the Water Chemistry Program to manage GALL Item III.A5-13 (stainless steel fuel pool liner material, item 3.5.1-46). The staff's review of the Water Chemistry Program is documented in SER Section 3.0.3.2.2. The staff finds that the credited AMP is appropriate, because the Water Chemistry Program monitors and controls the chemical environments of the TMI-1 primary cycle and secondary cycle systems such that aging effects of system components are minimized. Aging effects include loss of material/pitting and crevice corrosion. Since the applicant has committed to use the appropriate aging management programs for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to appropriate aging management programs for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Fuel Handling Building not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.8 Structures and Component Supports – Intake Screen and Pump House – Summary of Aging Management Evaluation – LRA Table 3.5.2-8

The staff reviewed LRA Table 3.5.2-8, which summarizes the results of AMR evaluations for the intake screen and pump house component groups.

In LRA Table 3.5.2-8, the applicant identified 111 unique component/material/environment/aging effect/AMP groups for the Intake Screen and Pump House. Ninety-one have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For five component types, the applicant proposed to manage reinforced concrete material, aging effect cracking, loss of bond and loss of material (spalling/scaling/corrosion of embedded steel, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note G and plant-specific Note 7, which states "the aging effects/mechanisms of interior concrete in a water-flowing environment include cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel. These aging effects/mechanisms are managed by the Structures Monitoring Program." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling/scaling) due to corrosion of embedded steel. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For five component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 5, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For four component types, the applicant proposed to manage reinforced concrete material, aging effect cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 6, which states "the aging effects/mechanisms of above grade exterior concrete in a water-flowing environment include cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel. These aging effects/mechanisms are managed by the Structures Monitoring Program." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) due to corrosion of embedded steel. Since the applicant has committed to appropriate aging management programs for the period of extended operation, the staff finds these AMR results to be acceptable.

For five component types, the applicant proposed no aging management program to manage GALL Item III.A6-3 (reinforced concrete material, item 3.5.1-34), aging effect none. These line items reference Note I and plant-specific Note 2, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Intake Screen and Pump House not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.9 Structures and Component Supports – Intermediate Building – Summary of Aging Management Evaluation – LRA Table 3.5.2-9

The staff reviewed LRA Table 3.5.2-9, which summarizes the results of AMR evaluations for the intermediate building component groups.

In LRA Table 3.5.2-9, the applicant identified 118 unique component/material/environment/aging effect/AMP groups for the Intermediate Building. Eighty-nine have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For fourteen component types, the applicant proposed to manage reinforced concrete material, aging effect cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note G. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of bond and loss of material (spalling, scaling) due to corrosion of embedded steel. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For seven component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 3, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate in each case, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For seven component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "The aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Intermediate Building not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.10 Structures and Component Supports – Mechanical Draft Cooling Tower Structures – Summary of Aging Management Evaluation – LRA Table 3.5.2-10

The staff reviewed LRA Table 3.5.2-10, which summarizes the results of AMR evaluations for the mechanical draft cooling tower structures component groups.

In LRA Table 3.5.2-10, the applicant identified 52 unique component/material/environment/aging effect/AMP groups for the Mechanical Draft Cooling Tower Structures. Thirty-two have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For six component types, the applicant proposed to manage reinforced concrete material, aging effect cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel and increase in porosity and permeability, loss of strength/leaching of calcium hydroxide, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note G. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) due to corrosion of embedded steel and increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For eleven component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 3, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures

Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate in each case because the Structures Monitoring Program performs visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For three component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Mechanical Draft Cooling Tower Structures not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.11 Structures and Component Supports – Miscellaneous Yard Structures – Summary of Aging Management Evaluation – LRA Table 3.5.2-11

The staff reviewed LRA Table 3.5.2-11, which summarizes the results of AMR evaluations for the miscellaneous yard structures component groups.

In LRA Table 3.5.2-11, the applicant identified 74 unique component/material/environment/aging effect/AMP groups for the Miscellaneous Yard Structures. Fifty-eight have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For eight component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 2, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate in each case because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For eight component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Miscellaneous Yard Structures not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.12 Structures and Component Supports – Natural Draft Cooling Tower – Summary of Aging Management Evaluation – LRA Table 3.5.2-12

The staff reviewed LRA Table 3.5.2-12, which summarizes the results of AMR evaluations for the natural draft cooling tower component groups.

In LRA Table 3.5.2-12, the applicant identified 28 unique component/material/environment/aging effect/AMP groups for the Natural Draft Cooling Tower. Twenty-two have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For two component types, the applicant proposed to manage reinforced concrete material, aging effect cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 3, which states "the aging effects/mechanisms of above grade exterior concrete in a water-flowing environment include cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel. These aging effects/mechanisms are managed by the Structures Monitoring Program." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of bond and loss of material (spalling, scaling) due to corrosion of embedded steel. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 4, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures

Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate in each case because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Natural Draft Cooling Tower not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.13 Structures and Component Supports – Structural Commodities – Summary of Aging Management Evaluation – LRA Table 3.5.2-13

The staff reviewed LRA Table 3.5.2-13, which summarizes the results of AMR evaluations for the structural commodities component groups.

In LRA Table 3.5.2-13, the applicant identified 109 unique component/material/ environment/aging effect/AMP groups for the structural commodities. Eighty-eight have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For one component type, the applicant proposed to manage aluminum (insulation jacketing) material, aging effect loss of material/pitting and crevice corrosion, by using the External Surfaces Monitoring Program. The staff's review of the External Surfaces Monitoring Program is documented in SER Section 3.0.3.2.16. These line items reference Note H, and plant-specific Note 4, which states "the aging effects of aluminum in this environment include loss of material due to pitting and crevice corrosion. These aging effects/mechanisms are managed by the External Surfaces Monitoring Program." The staff finds that the External Surfaces Monitoring Program requires visual inspections on a periodic basis to manage loss of material due to pitting and crevice corrosion; therefore, the credited AMP is appropriate in each case. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For eight component types, the applicant proposed to manage grout material, aging effect cracking/shrinkage and aggressive environment, by using the Structures Monitoring Program.

The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H, and plant-specific Note 6, which states "the aging effects/mechanisms of grout in this environment include cracking due to shrinkage and aggressive environment. These aging effects/mechanisms are managed by the Structures Monitoring Program." The staff finds that the Structures Monitoring Program requires visual inspections on a periodic basis to manage cracking due to shrinkage and aggressive environments; therefore the credited AMP is appropriate in each case. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage PVC (conduit) material, aging none, and none for management program. The staff reviewed the LRA, license design basis documents, EPRI 1002950 Structural Tools, Revision 1, August 2003, and the GALL Report and found that these materials do not perform or support any license renewal intended functions that satisfy the scoping criteria of 10 CFR 54.4(a). Therefore, aging management for these materials is not required.

For eleven component types, the applicant proposed to manage asbestos, calcium silicate, fiberglass, and Nukon® (insulation) material, aging none, and none for management program. The staff reviewed the LRA, license design basis documents, EPRI 1002950 Structural Tools, Revision 1, August 2003, and the GALL Report and found that these materials do not perform or support any license renewal intended functions that satisfy the scoping criteria of 10 CFR 54.4(a). Therefore, aging management for these materials is not required.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Structural Commodities not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.14 Structures and Component Supports – Reactor Building – Summary of Aging Management Evaluation – LRA Table 3.5.2-14

The staff reviewed LRA Table 3.5.2-14, which summarizes the results of AMR evaluations for the reactor building (containment) component groups.

In LRA Table 3.5.2-14 the applicant identified 352 unique component/material/environment/aging effect/AMP groups for the Reactor Building (Containment). Three hundred have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For two component types, the applicant proposed to manage epoxy material, aging effect loss of sealing/deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants), by using the 10 CFR Part 50, Appendix J Program. The staff's review of the 10 CFR Part 50, Appendix J Program is documented in SER Section 3.0.3.1.7. These line items reference Note F. The staff finds that the 10 CFR Part 50, Appendix J Program performs the containment leakage testing on a periodic basis to manage loss of sealing/deterioration of seals, gaskets, and moisture barriers; therefore, the credited AMP is appropriate in each case. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For three component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 7, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate in each case because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For five component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 2, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For seven component types, the applicant proposed no aging management program to manage GALL Item II.A1-4 (reinforced concrete material, item 3.5.1-1), aging effect none. These line items reference Note I and plant-specific Note 2, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For twenty-two component types, the applicant proposed to manage carbon steel; dissimilar metal welds (3.5.1-18) materials, aging effect loss of material general corrosion, by using ASME Section XI, Subsection IWE and 10 CFR Part 50, Appendix J programs. The staff's review of the ASME Section XI, Subsection IWE and 10 CFR Part 50, Appendix J Programs are documented in SER Section 3.0.3.2.19 and 3.0.3.1.7 respectively. These line items reference Note I and plant-specific Note 6, which states "loss of material due to pitting and crevice corrosion is not applicable for this material and environmental combination." The staff finds that the credited AMPs are appropriate, because the ASME Section XI, Subsection IWE and 10 CFR Part 50, Appendix J Programs require visual inspections and pressure testing on a periodic basis to manage loss of material general corrosion. Since the applicant has committed to appropriate aging management programs for the period of extended operation, the staff finds these AMR results to be acceptable.

For thirteen component types, the applicant proposed no aging management program to manage stainless steel; dissimilar metal welds (3.5.1-10 {II.A3-2}) material, aging effect none. These line items reference Note I and plant-specific Note 12, which states "Stress corrosion cracking is not applicable to stainless steel; dissimilar metal welds in environments of air with borated water leakage and air-indoor." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. On December 11, 2008, the staff asked the applicant to provide the technical basis for not following the GALL Report recommendation (RAI 3.5.2-14-0).

In the response e-mail dated December 12, 2008 (ML083500505) the applicant stated that the TMI-1 line items listed (3.5.1-10 {II.A3-2}) do not have an associated aging management program credited because there is no applicable aging effect identified that requires management. The applicant also stated that at TMI-1, these Reactor Building penetration components are associated with the Reactor Building but are actually located inside the adjoining Auxiliary Building, Fuel Handling Building and Turbine Building. The applicant further stated that the exterior surface of these penetration closure plates and welds are exposed to the air environments inside each of these adjoining buildings, and the interior surface is exposed to an air environment inside the annulus of the penetration, separated from the Reactor Building environment by a flexible bellows assembly on the end of the penetration inside the Reactor Building. The applicant further stated that the only environments that required evaluation are the air-indoor environment and the air with borated water leakage environment. The applicant again stated that these environments do not have chloride or sulfate levels sufficient to promote stress corrosion cracking, as stated in the LRA. The applicant further stated that the review of applicable operating experience has not identified stress corrosion cracking of any stainless steel components or dissimilar metal welds in an air-indoor environment or an air with borated water leakage environment. The applicant stated that this is also consistent with other NUREG-1801 line items for stainless steel in air-indoor (uncontrolled) environments where no aging effects are identified.

Since no aging effects are identified, the applicant concluded that no aging management program is needed. The staff reviewed the applicant responses, and found them acceptable because they are consistent with the GALL Report for stainless steel in air-indoor (uncontrolled) environments where no aging effects are identified.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Reactor Building (Containment) not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.15 Structures and Component Supports – SBO Diesel Generator Building – Summary of Aging Management Evaluation – LRA Table 3.5.2-15

The staff reviewed LRA Table 3.5.2-15, which summarizes the results of AMR evaluations for the SBO diesel generator building component groups.

In LRA Table 3.5.2-15, the applicant identified 39 unique component/material/environment/aging effect/AMP groups for the SBO Diesel Generator Building. Thirty-three have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For two component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 2, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate in each case because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For three component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the SBO Diesel Generator Building not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.16 Structures and Component Supports – Service Building – Summary of Aging Management Evaluation – LRA Table 3.5.2-16

The staff reviewed LRA Table 3.5.2-16, which summarizes the results of AMR evaluations for the service building component groups.

In LRA Table 3.5.2-16, the applicant identified 32 unique component/material/environment/aging effect/AMP groups for the Service Building. Twenty-seven have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For two component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 3, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Service Building not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.17 Structures and Component Supports – Component Supports Commodity Group – Summary of Aging Management Evaluation – LRA Table 3.5.2-17

The staff reviewed LRA Table 3.5.2-17, which summarizes the results of AMR evaluations for the component supports commodity groups.

In LRA Table 3.5.2-17, the applicant identified 89 unique component/material/environment/aging effect/AMP groups for the Component Supports Commodity Group. Sixty-eight have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate. For two component types, the applicant proposed to manage carbon and low alloy steel material, aging effect loss of material/crevice corrosion, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 8, which states "loss of material due to crevice corrosion is also predicted for this material and environment combination in addition to loss of material due to general and pitting corrosion for the NUREG-1801, Vol. 2 items identified as III.B1.1-13, III.B1.2-10, III.B3-7, III.B4-10, and III.B5-7." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material/crevice corrosion. Since the applicant has committed to appropriate aging management programs for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage galvanized steel material, aging effect loss of material/general corrosion, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 9, which states "loss of material due to general corrosion is also predicted for this material and environment combination in addition to loss of material due to pitting and crevice corrosion for the NUREG-1801, Vol. 2 items identified as III.B2-7." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material/general corrosion. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed to manage stainless steel (Item 3.5.1-49) material, aging effect loss of material/pitting and crevice corrosion, by using the ASME Section XI, Subsection IWF and Water Chemistry Program. The staff's review of the ASME Section XI, Subsection IWF and Water Chemistry Program are documented in SER Section 3.0.3.2.20 and 3.0.3.2.2 respectively. These line items reference Note I and plant-specific Note 7, which states "general corrosion is not predicted for this material and environment combination." The staff finds that the credited AMPs are appropriate, because the ASME Section XI, Subsection IWF and Water Chemistry Programs require visual inspections on a periodic basis to manage loss of material/pitting and crevice corrosion. Since the applicant has committed to appropriate aging management programs for the period of extended operation, the staff finds these AMR results to be acceptable.

For four component types, the applicant proposed to manage carbon and low alloy steel material (Item 3.5.1-39), aging effect loss of material/general corrosion, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note I and plant-specific Note 6, which states "pitting corrosion is not predicted for this material and environment combination." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material/general corrosion. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed to manage carbon and low alloy steel material (Item 3.5.1-53), aging effect loss of material/general corrosion, by using the ASME Section XI, Subsection IWF. The staff's review of the ASME Section XI, Subsection IWF is documented in SER Section 3.0.3.2.20. These line items reference Note I and plant-specific Note 6, which states "pitting corrosion is not predicted for this material and environment combination." The staff finds that the credited AMP is appropriate, because the ASME Section XI, Subsection IWF Program requires visual inspections on a periodic basis to manage loss of material/general corrosion. Since the applicant has committed to appropriate aging management programs for the period of extended operation, the staff finds these AMR results to be acceptable.

For ten component types, the applicant proposed no aging management program to manage steel material (Item 3.5.1-42 {III.B1.1-12 and III.B1.2-9}), aging effect none. These line items reference Note I and plant-specific Note 2, which states "cumulative fatigue damage is not a TLAA in the TMI-1 CLB." The staff reviewed the GALL Report recommendation for Item III.B1.1-12 and III.B1.2-9 and found an AMP is required only if a CLB fatigue analysis exists. Because cumulative fatigue damage is not a TLAA in the TMI-1 CLB, the staff finds an aging management program for these materials is not required.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Component Supports Commodity Group not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.18 Structures and Component Supports – Substation Structures – Summary of Aging Management Evaluation – LRA Table 3.5.2-18

The staff reviewed LRA Table 3.5.2-18, which summarizes the results of AMR evaluations for the substation structures component groups.

In LRA Table 3.5.2-18, the applicant identified 37 unique component/material/environment/aging effect/AMP groups for the Substation Structures. Thirty-two have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For two component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 2, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate because the Structures Monitoring

Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Substation Structures not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.19 Structures and Component Supports – Turbine Building – Summary of Aging Management Evaluation – LRA Table 3.5.2-19

The staff reviewed LRA Table 3.5.2-19, which summarizes the results of AMR evaluations for the turbine building component groups.

In LRA Table 3.5.2-19, the applicant identified 55 unique component/material/environment/aging effect/AMP groups for the Turbine Building. Forty two have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For six component types, the applicant proposed to manage reinforced concrete material, aging effect cracking, loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note G. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of bond and loss of material (spalling, scaling)/corrosion of embedded steel. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For three component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling, scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 3, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling, scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For three component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program require visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the Turbine Building not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.20 Structures and Component Supports – UPS Diesel Building – Summary of Aging Management Evaluation – LRA Table 3.5.2-20

The staff reviewed LRA Table 3.5.2-20, which summarizes the results of AMR evaluations for the UPS diesel building component groups.

In LRA Table 3.5.2-20, the applicant identified 28 unique component/material/environment/aging effect/AMP groups for the UPS Diesel Building. Twenty-three have AMR results consistent with GALL, as identified by reference to Notes A through E. The staff confirmed that the references to Table 1 and GALL Volume II line items are appropriate.

For two component types, the applicant proposed to manage reinforced concrete material, aging effect loss of material (spalling/scaling) and cracking/freeze-thaw, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note H and plant-specific Note 3, which states "the aging effects/mechanisms of exterior below grade concrete in a groundwater/soil environment include loss of material (spalling/scaling) and cracking due to freeze-thaw. These aging effects/mechanisms are managed by the Structures Monitoring Program. The Structures Monitoring Program is appropriate in this situation since loss of material (spalling/scaling) and cracking due to freeze-thaw is still present for exterior below grade concrete above the frost line." The staff finds that the credited AMP is appropriate in each case because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of material (spalling/scaling) and cracking due to freeze-thaw. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For two component types, the applicant proposed no aging management program to manage GALL Item III.A3-5 (reinforced concrete material, item 3.5.1-31), aging effect none. These line items reference Note I and plant-specific Note 1, which states "the aging effect is not applicable because the environment is not aggressive." The staff disagrees with the applicant's AMR conclusion that there are no aging effects requiring management for the period of extended operation for these groups. However, the staff finds the applicant has enhanced the Structures Monitoring Program (Commitment # 28) to perform groundwater sampling for non-aggressiveness once every five years. Since the applicant has committed to perform groundwater sampling in an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

For one component type, the applicant proposed to manage roofing material, aging effect loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering, by using the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.21. These line items reference Note J. The staff finds that the credited AMP is appropriate, because the Structures Monitoring Program requires visual inspections on a periodic basis to manage loss of weatherproofing integrity due to cracking, organic decomposition, separation, shrinkage, wear, and weathering. Since the applicant has committed to an appropriate aging management program for the period of extended operation, the staff finds these AMR results to be acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations for the UPS Diesel Building not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.3 Conclusion

The staff concludes that the applicant has provided sufficient information to demonstrate that, the effects of aging for the structures and component supports within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6 Aging Management of Electrical Commodity Group

This section of the SER documents the staff's review of the applicant's AMR results for the electrical and I&C components and component groups of the following:

- Insulated Cables and Connections
- Metal Enclosed Bus
- Fuse Holders
- Cable Connections (Metallic Parts)
- Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage
- High Voltage Insulators
- Transmission Conductors and Connections, Switchyard Bus and Connections

3.6.1 Summary of Technical Information in the Application

LRA Section 3.6 provides AMR results for the electrical and instrumentation and control system components and component groups. LRA Table 3.6.1, "Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of NUREG 1801," is a summary comparison of the applicant's AMRs with those evaluated in the GALL Report for the electrical and I&C system components and component groups.

The applicant's AMRs evaluated and incorporated applicable plant-specific and industry operating experience in the determination of AERMs. The plant-specific evaluation included condition reports and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.6.2 Staff Evaluation

The staff conducted an onsite audit of AMPs to ensure the applicant's claim that certain AMPs were consistent with the GALL Report. The purpose of this audit was to examine the applicant's AMPs and related documentation and to verify the applicant's claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff's evaluations of the AMPs are documented in SER Section 3.0.3. The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Section 3.6.2.1 and 3.6.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff's evaluation are discussed in SER Section 3.6.2.3.

For components which the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's operating experience to verify the applicant's claims.

SER Table 3.6-1 below, summarizes the staff's evaluation of components, aging effects/mechanisms, and AMPs listed in LRA Section 3.6 and addressed in the GALL Report.

Table 3.6-1 Staff Evaluation for Electrical and Instrumentation and Controls in the GALL Report

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Electrical equipment subject to 10 CFR 50.49 environmental qualification (EQ) requirements (3.6.1-1)	Degradation due to various aging mechanisms	Environmental Qualification of Electric Components	Yes	TLAA Environmental Qualification of Electrical Components	Further Evaluation (See Section 3.6.2.2.1)
Electrical cables, connections and fuse holders (insulation) not subject to 10 CFR 50.49 EQ requirements (3.6.1-2)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements	No	Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements	Consistent with GALL Report (See Section 3.6.2.1)
Conductor insulation for electrical cables and connections used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance (3.6.1-3)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables And Connections Used In Instrumentation Circuits Not Subject to 10 CFR 50.49 EQ Requirements	No	Electrical Cables And Connections Not Subject to 10 CFR 50.49 EQ Requirements Used In Instrumentation Circuits	Consistent with GALL Report (See Section 3.6.2.1)
Conductor insulation for inaccessible medium voltage (2 kV to 35 kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements (3.6.1-4)	Localized damage and breakdown of insulation leading to electrical failure due to moisture intrusion, water trees	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements	No	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements	Consistent with GALL Report (See Section 3.6.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
Connector contacts for electrical connectors exposed to borated water leakage (3.6.1-5)	Corrosion of connector contact surfaces due to intrusion of borated water	Boric Acid Corrosion	No	Boric Acid Corrosion	Consistent with GALL Report
Fuse Holders (Not Part of a Larger Assembly): Fuse holders - metallic clamp (3.6.1-6)	Fatigue due to ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation	Fuse Holders	No	No	Not applicable to TMI-1 (See Section 3.6.2.3)
Metal enclosed bus - bus, connections (3.6.1-7)	Loosening of bolted connections due to thermal cycling and ohmic heating	Metal Enclosed Bus	No	Metal Enclosed Bus	Consistent with GALL Report (See Section 3.6.2.1)
Metal enclosed bus - insulation, insulators (3.6.1-8)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Metal Enclosed Bus	No	Metal Enclosed Bus	Consistent with GALL Report (See Section 3.6.2.1)
Metal enclosed bus - enclosure assemblies (3.6.1-9)	Loss of Material/ General Corrosion	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with GALL Report (See Section 3.5.2.1)
Metal enclosed bus - enclosure assemblies (3.6.1-10)	Hardening and loss of strength due to elastomers degradation	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with GALL Report (See Section 3.5.2.1)

Component Group (GALL Report Item No.)	Aging Effect/ Mechanism	AMP in GALL Report	Further Evaluation in GALL Report	AMP in LRA, Supplements, or Amendments	Staff Evaluation
High voltage insulators (3.6.1-11)	Degradation of insulation quality due to presence of any salt deposits and surface contamination; loss of material caused by mechanical wear due to wind blowing on transmission conductors	A plant-specific aging management program is to be evaluated	Yes	No	Further Evaluation (See SER Section 3.6.2.2)
Transmission conductors and connections; switchyard bus and connections (3.6.1-12)	Loss of material due to wind induced abrasion and fatigue; loss of conductor strength due to corrosion; increased resistance of connection due to oxidation or loss of preload	A plant-specific aging management program is to be evaluated	Yes	No	Further Evaluation (See SER Section 3.6.2.2)
Cable Connections - metallic parts (3.6.1-13)	Loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	No	Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	Consistent with GALL Report (See Section 3.6.2.1)
Fuse Holders (Not Part of a Larger Assembly) - insulation material (3.6.1-14)	None	None	No	Not applicable	Consistent with GALL Report (See Section 3.6.2.1)

3.6.2.1 AMR Results That Are Consistent with the GALL Report

LRA Section 3.6.2.1 identifies the materials, environments, aging effects requiring management, and the following programs that manage aging effects for the electrical and I&C components:

- Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
- Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits
- Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
- Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
- Metal Enclosed Bus

LRA Table 3.6.2-1, summarizes the AMRs for the electrical and instrumentation and controls components and claims that these AMRs are consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL report and for which the GALL Report does not recommend further evaluation, the staff's review determined whether the plant-specific components of these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant noted for each AMR line item how the information in the tables aligns with the information in the GALL Report. The staff audited those AMRs with notes A through E indicating how the AMR is consistent with the GALL Report.

The staff audited and reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs.

The staff reviewed the LRA to confirm that the applicant: (a) provided a brief description of the system, components, materials, and environments; (b) stated that the applicable aging effects were reviewed and evaluated in the GALL Report; and (c) identified those aging effects for the electrical and I&C components that are subject to an AMR.

On the basis of its audit and review, the staff finds that, for AMRs not requiring further evaluation, as identified in LRA Table 3.6.1, the applicant's references to the GALL Report are acceptable and no further staff review is required.

The staff evaluated the applicant's claim of consistency with the GALL Report and the information pertaining to the applicant proposals for managing aging effects. On the basis of its review, the staff finds that the AMR results for which the applicant claimed consistency with the GALL Report, are consistent. The staff concludes that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation is Recommended

LRA Section 3.6.2.2 further evaluates aging management, as recommended by the GALL Report, for the electrical and I&C components and provided information concerning management of the following aging effects:

- Electrical equipment subject to EQ
- Degradation of insulator quality due to presence of any salt deposits and surface contamination, and loss of material due to mechanical wear
- Loss of material due to wind induced abrasion and fatigue; loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of pre-load
- QA for aging management of nonsafety-related components

For component groups evaluated in the GALL Report, for which the applicant claimed consistency with the GALL Report and for which the GALL Report recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues for which the GALL Report recommended further evaluation. In addition, the staff reviewed the applicant's further evaluations against the criteria contained in SRP-LR Section 3.6.2.2. The staff's review of the applicant's further evaluation follows.

3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification

LRA Section 3.6.2.2.1 states that EQ is a TLAA, as defined in 10 CFR 54.3. The staff noted that applicants must evaluate TLAAs in accordance with 10 CFR 54.21(c)(1). SER Section 4.8 documents the staff's review of the applicant's evaluation of this TLAA.

3.6.2.2.2 Degradation of Insulator Quality due to Presence of Any Salt Deposits and Surface Contamination, and Loss of Material due to Mechanical Wear

LRA Section 3.6.2.2.2 states that surface contamination can be a problem in areas where there are greater concentrations of airborne particles such as near facilities that discharge soot or near the sea coast where salt spray is prevalent. The applicant also stated that the plant is not located near the seacoast and that it is located inland, in central Pennsylvania. The applicant stated that the location is in an area where industrial airborne particle concentrations are comparatively low, since it is not located in a heavy industrial area and that minor contamination is washed away by rainfall or snow, and cumulative buildup has not been experienced and is not expected to occur.

The staff reviewed LRA Section 3.6.2.2.2 against the criteria in SRP-LR Section 3.6.2.2.2, which states that degradation of insulator quality due to salt deposits or surface contamination may occur in high-voltage insulators. The staff noted that the GALL Report recommends further evaluation of plant-specific AMPs for plants at locations of potential salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution). The staff also noted that loss of material due to mechanical wear caused by wind on transmission conductors,

may occur in high-voltage insulators and that the GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed.
The staff determined that since the plant is not located near facilities that discharge soot or near the sea coast and the applicant's plant specific operating experience did not identify any issues associated with contamination buildup, that degradation of insulators due to salt deposits or surface contamination is not an applicable aging effect requiring management for high-voltage insulators.

LRA Section 3.6.2.2.2 states that wind loading that can cause a transmission line and insulators to sway is considered in the design and installation of transmission lines, and that, although rare, surface rust of the metallic cap may form where galvanizing is burnt off due to flashover from lightening strikes. The applicant also stated that surface rust is not a significant concern and would not cause a loss of intended function if left unmanaged for the period of extended operation. The applicant further stated that it has not identified wear and surface rust during routine substation inspection.

The staff noted that although loss of material of insulators due to mechanical wear is possible, industry operating experience has shown that the transmission conductors do not normally swing significantly and that even when they do swing due to a substantial wind, they do not continue to swing for a very long time after the wind has subsided. The staff also noted that wind loading that can cause a transmission line and insulators to sway is considered during the design and installation of transmission lines and insulators. The staff also noted that surface rust is not an aging effect that can cause a loss of insulation intended function of high-voltage insulators because rust does not have any degradation effect on the surface of insulation.

Furthermore, the staff noted that the applicant's routine inspections have not identified any loss of material of insulators due to mechanical wear. In addition, the staff noted that since the transmission conductors within the scope of license renewal are short spans, the surface area exposed to wind loads are not significant. The staff finds that the loss of material due to wear is not considered an aging effect that will cause a loss of intended functions of the insulators. Based on its review, the staff finds that surface contamination and loss of material due to wear is not an applicable aging effect requiring management to the insulators.

3.6.2.2.3 Loss of Material due to Wind Induced Abrasion and Fatigue; Loss of Conductor Strength due to Corrosion, and Increased Resistance of Connection due to Oxidation or Loss of Pre-load

LRA Section 3.6.2.2.3 addresses loss of material due to wind-induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of pre-load. The applicant concluded that loss of material due to wind induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of pre-load are not aging effects requiring management.

The staff reviewed LRA Section 3.6.2.2.3 against the criteria in SRP-LR Section 3.6.2.2.3, which states that loss of material due to wind-induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connections due to oxidation or loss of pre-load may occur in transmission conductors and connections and in switchyard bus and connections. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed.

LRA Section 3.6.2.2.3 states that transmission conductor vibration or sway could be caused by wind loading. The applicant also stated that experience has shown that the transmission conductors do not normally swing significantly and that when they do swing due to a substantial wind, they do not continue to swing for very long once the wind has subsided.

The applicant stated that tests performed by Ontario Hydroelectric showed a 30% loss of composite conductor strength of an 80-year-old ACSR (Aluminum Conductor Steel Reinforced). The applicant also stated that the National Electrical Safety Code (NESC) requires that tension on installed conductors be a maximum of 60% of the ultimate conductor strength. The applicant stated that the NESC also sets the maximum tension a conductor must be designed to withstand under heavy load requirements, which includes consideration of ice, wind and temperature and that an example presented in the EPRI Report 1013475, "License Renewal Electrical Handbook," compares a 4/0 conductor to the results of the Ontario Hydroelectric Study. The applicant further stated that NESC requirements and the handbook guidance were applied to evaluate the in scope transmission conductors.

The applicant also stated that in scope transmission conductors are 795 MCM ACSR and because the transmission conductor design and installation meet the NESC requirements, it considers the Ontario Hydroelectric study to bound its configuration. The applicant further stated that the ultimate strength and NESC heavy load tension requirements of 795 MCM ACSR are 31500 lbs. and 11025 lbs, respectively. The staff noted that the margin between the NESC Heavy Load and the ultimate strength is 20475 lbs which provides a 65% ultimate strength margin. The staff noted that the Ontario Hydroelectric study showed a 30% loss of composite conductor strength in an 80-year-old conductor. The applicant stated that in the case of the 795 MCM ACSR transmission conductors, a 30% loss of ultimate strength would mean that there would still be a 35% ultimate strength margin between what is required by the NESC and the actual conductor strength. The applicant also stated that this illustrates with reasonable assurance that transmission conductors will have ample strength margin through the period of extended operation. The staff noted that the applicant did not address in full detail, the applicability of the Ontario Hydroelectric study. In RAI 3.6-2, dated October 16, 2008, the staff requested that the applicant provide additional information discussing the details of the Ontario Hydroelectric study and how transmission conductors are bounded by the Ontario Hydroelectric tests for 60 years.

In its response to the RAI dated November 12, 2008, the applicant stated that potential conductor degradation is measured by an eddy current sensor that travels along the conductor between transmission towers. The applicant further stated that laboratory tests were performed for fatigue, tensile strength, torsional ductility, and electrical performance and that fatigue tests simulating 50 years of service life were performed to assess existing cables as well as new cables. The applicant also stated that the in scope transmission conductors connect the auxiliary transformers to the switchyard and that the transmission conductors are 795 MCM 26/7 ACSR. The staff noted that this is the same type of transmission conductors evaluated in the Ontario Hydroelectric study. The applicant also stated that the 795 MCM 26/7 ACSR transmission conductor is approximately 1 inch in diameter and is configured with 7 steel conductors wrapped by 26 aluminum conductor versus the 4/0 6/1 ACSR conductor which is approximately ½ inch in diameter with a single steel conductor wrapped by six aluminum conductors. The rated or ultimate strength per ASTM standards for the 795 26/7 ACSR conductor is 31,500 lbs while the rated strength for the 4/0 6/1 ACSR conductor is 8,350 lbs. Therefore, the applicant concluded that the physical construction of the in scope transmission conductors' strength margin is bounded by the handbook analysis of the 4/0 ACSR conductor and is also bounded by the Ontario Hydroelectric study.

Based on its review, the staff finds the applicant's response to RAI 3.6-2 acceptable. The staff confirmed that the applicant's transmission conductors are bounded by those in the Ontario Hydroelectric study which used a sample of 336.4 MCM 30/7 ACSR conductors. The staff noted that this study showed a 30% loss of composite conductor strength in an 80-year-old conductor and that the ratio between the heavy loading and the ultimate conductor strength of a 80 year old transmission conductor (after losing 30% of conductor strength due to corrosion) is 50% (11025 lbs / (31500 x 70% lbs). The staff noted that the NESC requires that the maximum tension of installed conductors be not more than 60% of the rated breaking strength under NESC design conditions and that the ratio of maximum heavy load and the ultimate conductor strength of installed conductors are below the 60% NESC requirements. Furthermore, the staff noted that the length of transmission conductors in scope of license renewal is generally short span and that the transmission conductors connecting the switchyard to the startup transformer provide restoration of offsite power after a SBO event. The staff also noted that the loading of these transmission conductors is much less than the calculated heavy loading of a long span transmission line. Based on this information, the staff determined that loss of conductor strength due to corrosion of transmission conductor is not a significant aging effect requiring management for the period of extended operation. The staff finds that with a 30% loss of conductor strength, there is still ample margin between the NESC requirements and the actual conductor strength. The staff's concern described in RAI 3.6-2 is resolved.

LRA Section 3.6.2.2.3 states that bolted connections associated with the transmission conductors employ the use of good bolting practices consistent with the recommendations of EPRI 1003471, "Electrical Connector Application Guideline." The applicant also stated that bolting connections are treated with corrosion inhibitors to avoid connection oxidation and torque to avoid loss of pre-load, at the time of installation. The staff noted that in EPRI TR-104213, "Bolted Joint Maintenance & Application Guide," EPRI identified a special problem with Belleville washers. Specifically, EPRI identified hydrogen embrittlement as a recurring problem with Belleville washers and other springs because when the springs are electroplated, the plating process forces hydrogen into the metal grain boundaries and if the hydrogen is not removed, the spring may spontaneously fail at any time while in service. In RAI 3.6-3, dated October 16, 2008, the staff requested that the applicant provide additional information to describe the types of finishes the Belleville washers currently have and current activities used to confirm the effectiveness of switchyard bolted connections.

In its response to the RAI dated November 12, 2008, the applicant stated that electroplated Belleville washers are not in use in the switchyard connections. The applicant also stated that there are no aging effects for transmission conductor connections and switchyard bus connections that require an AMP. The applicant further stated that even though there are no aging effects requiring management, the switchyard connections are currently surveyed as part of preventive maintenance, via thermography, at a minimum of every six months in accordance with procedures and best preventive maintenance practices.

Based on its review, the staff finds the response to RAI 3.6-3 acceptable because electroplated Belleville washers are not used and hydrogen embrittlement is not an issue. The staff also finds that the applicant's current use of thermography to confirm the effectiveness of switchyard bolted connections to be acceptable because the use of anti-oxidant compounds will prevent the formation of oxides on metal surfaces and prevent moisture entering the connections, thus reducing the chances of corrosion that could increase resistance. The staff finds that increased resistance of connections due to oxidation or loss of pre-load are not aging effects requiring management. The staff's concern described in RAI 3.6-3 is resolved.

Based on its review, the staff finds that loss of material caused by transmission conductor vibration or sway and loss of conductor strength are not applicable aging effects requiring management. The staff also finds that the design of transmission connections using Bellville washers will eliminate the potential torque relaxation of bolted connections.

Based on a review of the programs identified above, including the applicant's response to RAIs 3.6-2 and 3.6-3, the staff concludes that the applicant's programs meet SRP-LR Section 3.6.2.2.3 criteria. For those line items that apply to LRA Section 3.6.2.2.3, the staff determines that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA program.

3.6.2.3 AMR Results That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Table 3.6.2-1, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

LRA Table 3.6.2-1 states that, via Notes F through J, the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant had demonstrated that the aging effects will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following section.

LRA Section 3.6.2.3.1 states that in-scope fuse holders, that are not part of a larger assembly, are located in three enclosed electrical boxes that contain only fuses and terminal blocks. The LRA also stated that two of the boxes contain fuses for the reactor protection system (RPS) nuclear instrumentation circuits. The applicant also stated that the fuse distribution panels VBA-1 and VBB-1 contain the fuses for the RPS nuclear instrumentation circuits and are located in the "A" and "B" Inverter Room, respectively, on elevation 322 feet of the control building and that the third box contains fuses for wireless telephone and radio equipment circuits. The applicant also stated that terminal box T1186 contains the fuses for wireless telephones and radio equipment and that it is located in the operations radio room on elevation of 322 feet of the turbine building. The applicant also stated that other fuse holders that are not part of a larger assembly are for circuits that do not perform a license renewal intended function.

The applicant stated that aging effects as discussed in the GALL Report are not applicable to the fuse holders in these three in scope electrical boxes. Regarding the moisture aging effect, the applicant stated that the fuse holders are located in three closed, metallic, electrical boxes that are protected from moisture by two barriers and that the first barrier is their indoor location in the control building and turbine building and that these locations do not see high relative humidity during normal conditions. The applicant also stated that the second barrier that protects the fuse holders from exposure to moisture is their location inside closed electrical boxes. Regarding the chemical aging effect, the applicant stated that the fuse holders are protected from chemical contamination by their location within closed electrical boxes and that there are no sources of chemicals in the vicinity of the electrical boxes. The applicant stated that oxidation and corrosion are not a concern since the fuse holders are not located in or near humid areas nor are they exposed to industrial or oceanic environments.

The applicant also stated that a walk down of these three electrical boxes containing the in scope fuse holders confirmed that the operating conditions for these fuse holders are clean and dry with no evidence of moisture intrusion, chemical contamination, oxidation, or corrosion. For fatigue, mechanical stress, and manipulation aging effects, the applicant stated that instrumentation and control circuits operate at low currents where no appreciable thermal cycling or ohmic heating occurs and that these fuse holders are for nuclear instrumentation and communication circuits that are lightly loaded. The applicant stated that electrical and thermal cycling is not an applicable aging mechanism for these fuse holders.

For mechanical stress due to forces associated with electrical faults and transients, the applicant stated that these stresses are mitigated by the fast action of circuit protective devices at high currents and that mechanical stress due to electrical faults is not considered a credible aging mechanism since such faults are infrequent and random in nature. For wear and fatigue, the applicant stated that the fuse holders are not subjected to frequent manipulation, (i.e., removal and reinsertion), because they are neither clearance nor isolation points that support periodic testing or preventive maintenance. Regarding the vibration aging effect, the applicant stated that the fuse holders are located in electrical boxes that are mounted to plant walls and are not mounted on moving or rotating equipment such as compressors, fans or pumps. The applicant further stated that because the electrical boxes are mounted on plant walls with no attached sources of vibration, vibration is not an applicable aging mechanism.

The staff reviewed issue report 00461358 that describes an incident where the root cause was found to be linked to a corroded fuse holder (inside an active assembly). As a result, the applicant took proper corrective action as described in work order C2012359. In RAI 3.6-1, dated October 16, 2008, the staff requested that the applicant provide additional information to explain why the potential corrosion of fuse holders inside the metallic electrical boxes due to condensation and an aging effect requiring management for those fuse holders is not applicable.

In its response to the RAI, dated November 12, 2008, the applicant stated that the final Apparent Cause Evaluation (ACE) for issue report 00461358 determined that the control circuit failure was the result of distortion of the removable fuse clips and not corrosion. The applicant further stated that this ACE includes laboratory analysis on a sampling of fuse/fuse block assemblies, which included the trip and close fuses/fuse block assemblies that were the initiators of the failure. The applicant also stated that the green material found on the fuse holder stabs, which can be an indication of corrosion, was determined to be electrical grease and that there was no evidence of corrosion products.

Based on its review, the staff finds the applicant's response to RAI 3.6-1 acceptable because the evaluation results showed that corrosion of fuse holders was not the initiator of the fuse failure. The staff's concern described in RAI 3.6-1 is resolved.

Based on its review, the staff finds that ohmic heating, thermal cycling, electrical transients, vibration, chemical contamination, fatigue, corrosion and oxidation are not applicable aging mechanisms/effects requiring management for the metallic clamps of the fuse holders within the scope of license renewal. The staff also finds that the applicant has appropriately evaluated AMR results involving material, environment, AERMs, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the aging effects will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.3 Conclusion

The staff concludes that the applicant has demonstrated that the aging effects associated with the electrical and I&C systems components will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable UFSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing the aging effects of the electrical and I&C systems, as required by 10 CFR 54.21(d).

The staff concludes that the applicant has provided sufficient information to demonstrate that the effects of aging for the electrical and I&C components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.7 Conclusion for Aging Management Review Results

The staff reviewed the information in LRA Section 3, "Aging Management Review Results," and Appendix B, "Aging Management Programs." On the basis of its review of the AMR results and AMPs, the staff concludes that the applicant has demonstrated that the aging effects will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable UFSAR Supplement program summaries and concludes that the UFSAR Supplement adequately describes the AMPs credited for managing aging as required by 10 CFR 54.21(d).

With regard to these matters, the staff concludes that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB, and any changes made to the CLB, in order to comply with 10 CFR 54.21(a)(3), are in accordance with the NRC's regulations.

SECTION 4

TIME-LIMITED AGING ANALYSES

4.1 Identification of Time-Limited Aging Analyses

This section of the safety evaluation report (SER) addresses the identification of time-limited aging analyses (TLAAs). In Sections 4.2 through 4.8 of the license renewal application (LRA), AmerGen Energy Company, LLC (AmerGen or the applicant) addressed the TLAAs for Three Mile Island Nuclear Station, Unit 1, (TMI-1). SER Sections 4.2 through 4.8 document the review of the TLAAs conducted by the staff of the U.S. Nuclear Regulatory Commission (NRC or the staff).

TLAAs are certain plant-specific safety analyses that involve time-limited assumptions defined by the current operating term. Pursuant to Title 10, Section 54.21(c)(1), of the *Code of Federal Regulations* (10 CFR 54.21(c)(1)), applicants must list TLAAs as defined in 10 CFR 54.3, "Definitions."

In addition, pursuant to 10 CFR 54.21(c)(2), applicants must list existing plant-specific exemptions granted under 10 CFR 50.12, "Specific Exemptions," based on TLAAs. For any such exemptions, the applicant must evaluate and justify the continuation of the exemptions for the period of extended operation.

4.1.1 Summary of Technical Information in the Application

To identify the TLAAs, the applicant evaluated calculations for TMI-1 against the six criteria specified in 10 CFR 54.3. The applicant indicated that it has identified the calculations that met the six criteria by searching the current licensing basis (CLB). The CLB includes the updated final safety analysis report (UFSAR), engineering calculations, technical reports, engineering work requests, licensing correspondence, and applicable vendor reports. In LRA Table 4.1-1, "Time Limited Aging Analysis Applicable to Three Mile Island Unit 1," the applicant listed the following applicable TLAAs:

- Neutron Embrittlement of the Reactor Vessel and Internals
- Metal Fatigue of Piping and Components
- Leak-Before-Break Analysis of Primary System Piping
- Fuel Transfer Tube Bellows Design Cycles
- Crane Load Cycle Limits
- Loss of Prestress in Concrete Containment Tendons
- Environmental Qualification of Electrical Equipment

Pursuant to 10 CFR 54.21(c)(2), the applicant stated that it had identified two exemptions granted under 10 CFR 50.12 that were based on a TLAA, as defined in 10 CFR 54.3.
The first exemption concerns the end-of-license neutron fluence. This exemption request was submitted by the applicant on March 29, 2001 and requested an exemption from the requirements of 10 CFR 50, Appendix G and 10 CFR 50, Section 50.61(a)(5), in order to

address provisions of amendments to the Technical Specification Pressure – Temperature Limit Curves. The exemption would allow the use of American Society of Mechanical Engineers (ASME) Code Cases and an alternative approach as follows:

- Code Case N-588, which permits the use of circumferentially oriented flaws in circumferential welds for development of Pressure-Temperature (P-T) limits
- Code Case N-640, which permits application of the lower bound static initiation fracture toughness value equation as the basis for establishing the P-T curves in lieu of using the lower bound crack arrest fracture toughness value equation
- The master curve approach for determining the initial reference temperature for weld metal WF-70 in the TMI-1 reactor vessel.

The above exemption does not need to be continued for the period of extended operation because the 29 EFPY P-T limit curves for which the exemption was granted will not be used during the period of extended operation.

The second exemption concerns 10 CFR 50 Appendix A, General Design Criterion 4. This exemption request concerned the requirement to assume a break equivalent to the double-ended rupture of the largest pipe in the reactor coolant system.

The LRA states that the Leak-Before-Break (LBB) evaluation includes a fatigue flaw growth analysis based upon thermal cycles associated with 40 years of plant operation. The applicant further stated that the evaluation addresses thermal aging of reactor coolant pump (RCP) casings for the current license period and that both TLAAs are evaluated for the period of extended operation which includes the basis for continuing this exemption for the period of extended operation.

4.1.2 Staff Evaluation

LRA Table 4.1-1 lists the TLAAs the applicant identified as being applicable to TMI-1. The staff reviewed the information to determine whether the applicant had provided sufficient information pursuant to 10 CFR 54.21(c)(1) and 10 CFR 54.21(c)(2).

As defined in 10 CFR 54.3, TLAAs meet the following six criteria:

(1) involve systems, structures, and components within the scope of license renewal, pursuant to 10 CFR 54.4(a)

(2) consider the effects of aging

(3) involve time-limited assumptions defined by the current operating term (for example, 40 years)

(4) are determined to be relevant by the applicant in making a safety determination

(5) involve conclusions, or provide the basis for conclusions, related to the capability of the system, structure, and component to perform its intended functions, pursuant to 10 CFR 54.4(b)

(6) are contained or incorporated by reference in the CLB

The applicant provided a list of potential TLAAs from NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," (SRP-LR) dated September 2005. The applicant listed those potential TLAAs applicable to TMI-1 in LRA Table 4.1-2, "Review of Analyses Listed in NUREG-1800, Tables 4.1-2 and 4.1-3." The applicant further provided a list of examples of plant-specific TLAAs from the SRP-LR in LRA Table 4.1-3.

As required by 10 CFR 54.21(c)(2), the applicant must list all exemptions granted in accordance with 10 CFR 50.12, based on TLAAs, and evaluated and justified for continuation through the period of extended operation. The LRA states that each active exemption was reviewed to determine whether it was based on a TLAA. The applicant identifies two TLAA-based exemptions. Based on the information provided by the applicant regarding the results of the applicant's search of the CLB to identify these exemptions, the staff has determined, in accordance with 10 CFR 54.21(c)(2), that there is one TLAA-based exemption which has been justified for continuation through the period of extended operation.

4.1.3 Conclusion

On the basis of its review, the staff concludes that the applicant has provided an acceptable list of TLAAs, as required by 10 CFR 54.21(c)(1), and that one exemption has been granted on the basis of a TLAA for which continuation has been justified during the period of extended operation as specified in 10 CFR 54.21(c)(2).

4.2 Neutron Embrittlement of the Reactor Vessel and Internals

The regulations that govern reactor vessel integrity are in 10 CFR Part 50:

- Section 50.60 of 10 CFR requires all light-water reactors to meet 10 CFR Part 50 Appendices G and H regarding fracture toughness, pressure-temperature (P-T) limits, and material surveillance program requirements for the reactor coolant boundary

- Section 50.61 of 10 CFR provides fracture toughness requirements for protection against pressurized thermal shock

Neutron embrittlement describes changes in mechanical properties of reactor vessel (RV) materials in the vicinity of the reactor core beltline region, i.e., the region defined by the upper and lower active core planes. The metric of neutron exposure is fluence, i.e., the time integral of neutron flux with energies greater than 1.0 MeV. The most pronounced material change, relevant to this case, is reduction in fracture toughness with increasing fluence. As fracture toughness decreases with cumulative fast neutron exposure, the material's resistance to crack propagation decreases. Fracture toughness of ferritic materials depends upon temperature. The reference temperature for nil-ductility transition, RT_{NDT}, is the transition temperature above which the material is ductile, and below which it is brittle. As neutron fluence increases, the RT_{NDT} increases and higher temperatures are required for the material to remain ductile. This shift in reference temperature is denoted as adjusted reference temperature (ART) and is equal to the sum $RT_{NDT} + \Delta RT_{NDT}$ + a margin term where ΔRT_{NDT} is the difference induced by the fluence exposure. Determination of the projected RV reduction in fracture toughness as a function of neutron fluence affects several analyses that support TMI-1 operations:

- RV Adjusted Reference-Temperature
- RV Material Upper-Shelf Energy (USE)
- RV Pressurized Thermal Shock (PTS)
- Pressure-Temperature Limits (P-T Limits)

As extension of the operating period from 40-years to 60-years will increase neutron fluence, the 60-year fluence value and its impact upon the analyses that support operation must be determined.

4.2.1 Neutron Fluence Analysis

4.2.1.1 Summary of Technical Information in the Application

LRA Section 4.2.1 discusses a fluence calculation that is based on a 100-% capacity factor for the period of extended operation. This fluence calculation predicts fast neutron exposure for the reactor vessel for 52 effective full power years (EFPY). The LRA states that the reactor vessel is expected to accrue 49.6 EFPY at the end of the 60-year operating life.
In the LRA, the applicant stated that the fluence calculation supporting the 60-year operating life included a benchmark comparison to measured cavity dosimetry test results, and that the projections were determined to meet the uncertainty requirements of Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence."

The LRA also stated that the fluence calculation was performed using an NRC-approved methodology.

In summary, the applicant provided the following information concerning the reactor vessel fluence projection that is significant to the NRC staff's evaluation:

- The applicant has projected reactor vessel fluence to the end of the renewed 60-year operating life
- The fluence projections account for 52 EFPY of exposure, and the end-of-life exposure is, based on a 100-% capacity factor, predicted to be 49.6 EFPY
- The fluence projections were benchmarked using plant specific cavity dosimetry
- The fluence projections were calculated using an NRC-approved methodology that has been found to adhere to the guidance of RG 1.190, Revision 2 [*sic*]

4.2.1.2 Staff Evaluation

The applicant identified reactor vessel neutron embrittlement as a TLAA. The neutron embrittlement analyses are supported by a fluence calculation, which was submitted to the NRC in a letter dated September 10, 2008. LRA Section 4.2.1 discusses the calculations, and the applicant states that the calculations are performed to be consistent with the guidance contained in RG 1.190.

The NRC staff evaluated the fluence determination to establish that it adheres to the guidance contained in RG 1.190. In consideration of this guidance and the regulations set forth in 10 CFR 54, this evaluation establishes that (1) the licensee's fluence determination methods employed in the analysis of surveillance capsule "T" follow the guidance presented in RG 1.190, and (2) that the fluence determination accounts for the period of extended operation, consistent with 10 CFR 54.21(c)(1)(i).

RG 1.190 describes methods and assumptions acceptable to the NRC staff for determining the pressure vessel neutron fluence with respect to the general design criteria (GDC) contained in Appendix A to 10 CFR 50. By considering the applicable GDC, the NRC staff establishes that the neutron fluence calculation adequately supports the reactor vessel neutron embrittlement analyses, such that compliance with 10 CFR 54.21(c)(1) can be determined. In this case, the evaluation establishes that the applicant's neutron fluence calculations, which provide input to the neutron embrittlement-related TLAA, have been projected for the period of extended operation, thus demonstrating compliance with 10 CFR 54.21(c)(1)(ii) as it pertains to the reactor vessel fluence calculation.

In consideration of the guidance set forth in RG 1.190, GDC 14, 30, and 31 are applicable. GDC 14, "Reactor Coolant Pressure Boundary," requires the design, fabrication, erection, and testing of the reactor coolant pressure boundary so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. GDC 30, "Quality of Reactor Coolant Pressure Boundary," requires, among other things, that components comprising the reactor coolant pressure boundary be designed, fabricated, erected, and tested to the highest quality standards practical. GDC 31, "Fracture Prevention of Reactor Coolant Pressure Boundary," pertains to the design of the reactor coolant pressure boundary, stating:

> The reactor coolant pressure boundary shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions, (1) the boundary behaves in a non-brittle manner and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the boundary material under operating maintenance, testing and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of irradiation on material properties, (3) residual, steady state and transient stresses, and (4) size of flaws.

The NRC staff evaluated the applicant's fluence projections to determine if the projections adequately account for the period of extended operation. Based on a 100-% capacity factor, the applicant predicts that the period of extended operation will result in 49.6 EFPY of exposure. In actuality, the applicant's fluence projections extend to 52 EFPY. The NRC staff accepts these projections because they are conservative with respect to the predicted peak, end-of-life exposure for the following two reasons: (1) the 100-% capacity factor is conservative in that the reactor will not accrue such exposure, because the reactor must incur outage time for refueling and other operational issues, which will reduce the actual capacity factor relative to the 100-% assumption; and (2) the 52 EFPY fluence projection bounds the 49.6 EFPY projected, end-of-life exposure. For these two reasons, the NRC staff finds that the 52 EFPY fluence projection adequately accounts for the neutron exposure during the period of extended operation.

The NRC staff evaluated the applicant's fluence calculations to determine if the projections were made using an approved methodology that adheres to the guidance contained in RG 1.190. The LRA states that the fluence calculation methodology adheres to the guidance contained in RG 1.190, Revision 2. The staff noted that Revision 2 to RG 1.190 does not exist. In part 2 of RAI 4.2.0.0-01, dated August 20, 2008, the staff requested that the applicant provide additional information to clarify the correct edition of RG 1.190 that was used.

In its response to part 2 of the RAI dated September 10, 2008, the applicant stated that the reference to Revision 2 is an error, and that the fluence calculation adheres to the guidance contained in the RG 1.190 dated March 2001.

Based on its review, the staff finds that applicant's response to part 2 of RAI 4.2.0.0-01 acceptable because the applicant has correctly identified the applicable regulatory guidance for neutron fluence calculations. The staff's concern described in part 2 of RAI 4.2.0.0-01 is resolved.

To reach its determination regarding the adherence of the applicant's fluence calculation to RG 1.190 the staff determined that additional information was needed. In part 1 of RAI 4.2.0.0-01, dated August 20, 2008, the staff requested that the applicant provide additional information regarding the referenced fluence calculation.

In its response to part 1 of the RAI dated September 20, 2008, the applicant provided the additional information requested by the staff. The staff reviewed the information submitted to determine the following with regard to RG 1.190:

(1) Whether the fluence calculations were performed using an NRC-approved methodology

(2) Whether the methodology adheres to the guidance contained in regulatory position 1 as set forth in RG 1.190

(3) Whether the fluence benchmarking adheres to the guidance contained in regulatory positions 2 and 3 as set forth in RG 1.190.

The applicant stated that the calculation describing the fluence analysis was performed using the methodology described in BAW-2241NP-A, which was previously reviewed and approved by the NRC.

BAW-2241NP-A, Revision 2, "Fluence and Uncertainty Methodologies," was approved by the staff as described in a safety evaluation issued to Areva NP on April 28, 2006. While this revision expanded the applicability of the fluence calculation methodology to additional types of reactors, the original approval determined the applicability of the methodology to Babcock and Wilcox reactors such as TMI-1. The staff's original and subsequent approvals are documented in BAW-2241NP-A, Revision 2. Therefore, the NRC staff concludes that the licensee's fluence calculation methodology has been approved by the NRC.

The staff's approval of BAW-2241NP-A, Revision 2, describes the method's adherence to the guidance set forth in RG 1.190 (Items 2 and 3 of the list above), and the acceptability of the code benchmarking to vessel configurations similar to TMI-1. Hence, the methodology and its benchmarking have been found to adhere to the guidance in RG 1.190. On this basis, the licensee's fluence calculation methodology used in support of the requested license renewal is acceptable.

In addition to the generic methodology benchmarking described in BAW-2241NP-A, in a letter dated September 10, 2008, the applicant provided the results of specific benchmarking based on cavity dosimetry. The average calculated-to-measured ratio of the cavity dosimetry was 1.04, with a standard deviation of 0.07. This is within the ±20% benchmark uncertainty recommended by RG1.190, and is acceptable to the staff.

Based on its review, the staff finds the applicant's response to part 1 of RAI 4.2.0.0-01 acceptable because the applicant's fluence calculation methodology and its benchmarking adhere to the guidance in RG 1.190. The staff's concern described in part 1 of RAI 4.2.0.0-01 is resolved.

4.2.1.3 UFSAR Supplement

The applicant provided an UFSAR Supplement summary description of its TLAA evaluation of neutron fluence analysis in LRA Section A.4.2.1. On the basis of its review of the UFSAR Supplement, the staff concludes that the summary description of the applicant's actions to address neutron fluence is adequate.

4.2.1.4 Conclusion

The applicant has provided fluence calculations performed using an acceptable methodology, supported by analytic uncertainty analysis and comparison to approved test facilities and benchmarked using plant-specific cavity dosimetry. The methodology and benchmarking are found to be adherent to the guidance contained in RG 1.190, and hence acceptable to the NRC staff.

Additionally, the NRC staff finds that the applicant's fluence projection extends to 52 EFPY, which conservatively bounds the period of extended operation, based on a 100-% capacity factor. As discussed above, the use of a 52 EFPY end-of-life exposure is acceptable because the 100-% capacity factor assumption on which it is based is conservative.

On the basis of its review, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that for reactor vessel neutron fluence, the analyses have been projected to the end of the period of extended operation. The staff also concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.2.2 Charpy Upper-Shelf Energy for Beltline Plates and Forgings

4.2.2.1 Summary of Technical Information in the Application

LRA Section 4.2.2 summarizes the evaluation of the upper-shelf energy (USE) analysis for the TMI-1 plates and forgings for the period of extended operation. Fracture toughness is a measure of a material's resistance to crack propagation. Charpy V-notch tests indirectly estimate fracture toughness, and Charpy V-notch test results are measured in ft.-lbs. of absorbed energy. The more ductile a material, the higher the fracture toughness and the more ft.-lbs. of energy will be absorbed during the Charpy V-notch test. The fracture toughness of RV steels is temperature-dependent. At low temperatures, the vessel material toughness is relatively low and constant and the material behaves in a brittle fashion. Rising temperatures reach a point where the toughness increases rapidly until another plateau where the toughness is relatively high and constant. In this high toughness region, the material is ductile. These regions of the curve are the lower shelf, transition zone, and upper shelf, respectively. Title 10 of the *Code of Federal Regulations* (CFR) Part 50, Appendix G contains screening criteria that limit the degree that the USE value for a RV material may be allowed to drop due to neutron radiation exposure. The regulation requires the initial RV material USE to be equal to or above 75 ft.-lb. and for the USE to be equal to or above 50 ft.-lb. throughout the licensed life of the vessel, unless lower values of USE can be demonstrated to provide margins of safety against fracture equivalent to those required by the Appendix G of the American Society of Mechanical Engineers (ASME) Code, Section XI.

An analysis of the USE of the TMI-1's RV beltline plate and forging materials for the license renewal period [52 effective full power years (EFPY)] requires the use of Regulatory Guide (RG) 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials." The RV USE analyses were at the 1/4T wall location of each beltline material using the respective copper contents, projected fluences, and Position 1.2 of the RG 1.99, Revision 2. From the RV USE analyses of the TMI-1 plates and forgings, the lowest predicted USE (64 ft.-lbs.) at 52 EFPY is that for lower shell plate C3251-1.

4.2.2.2 Staff Evaluation

The staff reviewed LRA Section 4.2.2 to verify pursuant to 10 CFR 54.21(c)(1)(ii) that the analysis has been projected to the end of the period of extended operation.

Section IV.A.1 to 10 CFR Part 50, Appendix G provides the Commission's requirements for demonstrating that RVs in U.S. light-water reactor facilities will have adequate protection from brittle failure throughout their service lives. The rule requires RV beltline materials to have USE values equal to or above 75 ft-lb when the materials are in the unirradiated condition and equal to or above 50 ft-lb throughout the licensed life of the RV. RG 1.99, Revision 2 provides an expanded discussion regarding the calculations of USE values and describes two methods for determining USE values for RV beltline materials, depending on whether or not a given RV beltline material is represented in the plant's Reactor Vessel Material Surveillance Program.

The applicant provided its USE analyses for the RV beltline plate and forging materials of TMI-1 in Table 4.2.2-1 of the LRA. The USE analyses were based on the 1/4T neutron fluence values listed in LRA Table 4.2.2-1 and these neutron fluence values were based on the projected values at the end of the extended period of operation (i.e., at 52 EFPY). The staff performed independent calculations of the USE values for the RV beltline plate and forging materials through the expiration of the extended period of operation. The staff applied the methods provided in RG 1.99, Revision 2 for performing the independent USE calculations. The staff determined that for the TMI-1 plates and forgings, lower shell plate C3251-1 is the limiting material. The staff calculated a USE value of 64 ft-lb for the TMI-1 lower shell plate at 52 EFPY and this value is in agreement with the value calculated by the applicant for this plate. This value meets the acceptance criterion in 10 CFR Part 50, Appendix G for maintaining the USE values of the RV beltline materials above 50 ft-lbs throughout the licensed life of the plant. Therefore, since the bounding plate and forging material for the TMI-1 RV meets the requirements of 10 CFR Part 50, Appendix G, all of the TMI-1 RV beltline plate and forging materials meet the regulatory requirements.

4.2.2.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of Charpy USE for beltline plates and forgings in LRA Section A.4.2.2. On the basis of its review of the UFSAR Supplement, the staff has determined that the summary description of the applicant's actions to address Charpy USE for beltline plates and forgings is adequate.

4.2.2.4 Conclusion

Based on the technical assessments stated above, the staff determined that the RV plate and forging materials at TMI-1 will maintain an acceptable level of USE values throughout the expiration of the extended period of operation. The staff concludes that the applicant's TLAA for USE for TMI-1 RV plate and forging materials, as given in Section 4.2.2 of the LRA, is in compliance with requirements of 10 CFR Part 50, Appendix G and, therefore, is acceptable.

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that the USE analysis for TMI-1 RV plate and forging materials has been projected to the end of the period of extended operation.

4.2.3 Charpy Upper-Shelf Energy for Beltline Welds (Equivalent Margins Analysis)

4.2.3.1 Summary of Technical Information in the Application

LRA Section 4.2.3 summarizes the evaluation of the upper shelf energy (USE) analysis for the TMI-1 beltline welds for the period of extended operation. Fracture toughness is a measure of a material's resistance to crack propagation. Charpy V-notch tests indirectly estimate fracture toughness, and Charpy V-notch test results are measured in ft.-lbs. of absorbed energy. The more ductile a material, the higher the fracture toughness and the more ft.-lbs. of energy will be absorbed during the Charpy V-notch test. The fracture toughness of RV steels is temperature-dependent. At low temperatures, the vessel material toughness is relatively low and constant and the material behaves in a brittle fashion. Rising temperatures reach a point where the toughness increases rapidly until another plateau where the toughness is relatively high and constant. In this high toughness region, the material is ductile. These regions of the curve are the lower shelf, transition zone, and upper shelf, respectively. Title 10 of the *Code of Federal Regulations* (CFR) Part 50, Appendix G contains screening criteria that limit the degree that the USE value for a RV material may be allowed to drop due to neutron radiation exposure. The regulation requires the initial RV material USE to be equal to or above 75 ft.-lb. and for the USE to be equal to or above 50 ft.-lb. throughout the licensed life of the vessel, unless lower values of USE can be demonstrated to provide margins of safety against fracture equivalent to those required by the Appendix G of the American Society of Mechanical Engineers (ASME) Code, Section XI. The 40-year Charpy USE values for all Linde 80 beltline welds are less than 50 ft.-lbs, therefore, in accordance with the requirements of 10 CFR Part 50, Appendix G, an equivalent margins analysis using projected 40-year fluence values was required. This equivalent margins analysis identified welds WF-25 and SA-1526 as limiting welds. An equivalent margins analysis for 48 EFPY had previously been reported in AREVA Generic License Renewal Technical Report BAW-2251A, Appendix B (BAW-2275), which was approved by the NRC. The analysis was updated from 48 EFPY to 52 EFPY to determine the associated fracture toughness properties for the TMI-1 limiting welds after 60-years of operation.

The updated equivalent margins analysis considered the effect of the increased fluence on the material J-integral resistance, J_R, a material property that is a function of fluence and copper content. The equivalent margins acceptance criterion from Appendix K of the ASME Code for J at Level A and B service loadings is based on a ductile flaw extension of 0.10 inch and is satisfied when $J_1 < J_{0.1}$ (where $J_{0.1}$ equals the material J-integral resistance (J_R) that will result in a ductile flaw extension of 0.1 inch and J_1 equals the applied J-integral with a safety factor of 1.15 on pressure and a safety factor of 1.0 on thermal loading). For the limiting circumferential weld WF-25, the material J-integral resistance is reduced from 543 in-lb/in^2 to 528 in-lb/in^2 due to the increase in ¼ T fluence from 48 EFPY (7.00 x 10^{18} n/cm^2, E > 1 MeV) to 52 EFPY (1.119 x 10^{19} n/cm^2, E > 1 MeV). The J_1 value for weld WF-25 remains 170 in-lb/in^2, therefore the $J_{0.1}/J_1$ ratio changes from 3.20 to 3.11. For the limiting axial weld SA-1526, J_R is reduced from 545 in-lb/in^2 to 543 in-lb/in^2 due to the increase in ¼ T fluence from 48 EFPY (6.55 x 10^{18} n/cm^2, E > 1 MeV) to 52 EFPY (6.884 x 10^{19} n/cm^2, E > 1 MeV). The J_1 value for weld WF-25 remains 502 in-lb/in^2, therefore the $J_{0.1}/J_1$ ratio changes from 1.09 to 1.08. For C and D service loads, the limiting weld is SA-1526. The 52 EFPY fluence at the T/10 location is 0.961 x 10^{19} n/cm^2. This is approximately equal to the fluence evaluated in BAW-2275, 0.955 x 10^{19} n/cm^2. The values of J_R and $J_{applied}$ in BAW-2275 are 545 and 241, respectively, yielding a margin of 2.26. Since the updated fluence for SA-1526 at the T/10 location is essentially unchanged, J_R is not affected and the margin of J_R to $J_{applied}$ will be approximately 2.26, which is well above the acceptance criterion of 1.0. Therefore, for 52 EFPY, the conclusions reported in BAW-2275 remain valid regarding the evaluation of Level C service loads relative to J_R and $J_{applied}$ and to Level C and D service loads relative to ductile and stable flaw extension. The analysis and conclusions demonstrate that welds WF-25 and SA-1526 satisfy the acceptance criteria of the ASME Code, Section XI, Appendix K, and therefore provide margins of safety against fracture equivalent to those required by Appendix G of Section XI to the ASME Code. Therefore, welds WF-25 and SA-1526 have adequate upper-shelf toughness and satisfy the requirements of Appendix G to 10 CFR Part 50, Section IV.A.1.a at the reactor vessel life of 52 EFPY (60 years).

4.2.3.2 Staff Evaluation

The staff reviewed LRA Section 4.2.3 to verify pursuant to 10 CFR 54.21(c)(1)(ii) that the analysis has been projected to the end of the period of extended operation.

Section IV.A.1 to 10 CFR Part 50, Appendix G provides the Commission's requirements for demonstrating that RVs in U.S. light-water reactor facilities will have adequate protection from brittle failure throughout their service lives. The rule requires RV beltline materials to have USE values equal to or above 75 ft-lb when the materials are in the unirradiated condition and equal to or above 50 ft-lb throughout the licensed life of the RV, "unless it is demonstrated in a manner approved by the Director, Office of Nuclear Reactor Regulation, that lower values of Charpy upper-shelf energy will provide margins of safety against fracture equivalent to those required by Appendix G of Section XI of the ASME Code." Topical Report BAW-2275, addressed the issue of low-upper-shelf fracture toughness for Linde 80 welds in Babcock & Wilcox (B&W) vessels, for an extended license period of 48 EFPY. NRC staff reviewed BAW-2275 using the calculational procedures and evaluation criteria of Appendix K of the ASME Code, and approved the report (ADAMS ML0036702807). NRC staff concluded that the TMI-1 Linde 80 welds satisfy the acceptance criteria of Appendix K of Section XI of the ASME Code, hence the TMI-1 Linde 80 welds have margins equivalent to those of Appendix G of Section XI of the ASME Code.

Staff reviewed effect of the increased fluence values, from 48 EFPY to 52 EFPY, on the material J-integral resistance, J_R. The material property, J_R, is a function of fluence and copper content. Copper contents of the TMI-1 limiting materials did not change from BAW-2275. The staff confirmed that welds WF-25 and SA-1526 satisfy the requirement of $J_1 < J_{0.1}$ for Level A and B service loadings (with respective values for J_1 and $J_{0.1}$ of 170 in-lb/in^2 and 543 in-lb/in^2 at 48 EFPY and 170 in-lb/in^2 and 528 in-lb/in^2 at 52 EFPY for WF-25; and respective values for J_1 and $J_{0.1}$ of 502 in-lb/in^2 and 545 in-lb/in^2 at 48 EFPY and 502 in-lb/in^2 and 543 in-lb/in^2 at 52 EFPY for SA-1526). The staff confirmed that all $J_{0.1}/J_1$ ratios remain greater than 1. For Level C and D service loads, the staff agreed that the 52 EFPY fluence at the T/10 location is essentially equivalent to the 48 EFPY fluence at the T/10 location evaluated in BAW-2275. Therefore, the margin of J_R to $J_{applied}$ remains at 2.26, well above the acceptance criteria of 1.0.

4.2.3.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of Charpy USE for beltline welds in LRA Section A.4.2.3. On the basis of its review of the UFSAR Supplement, the staff has determined that the summary description of the applicant's actions to address Charpy USE for beltline welds is adequate.

4.2.3.4 Conclusion

Based on the technical assessments stated above, the staff determined that the RV weld materials at TMI-1 satisfy the acceptance criteria of Appendix K of Section XI of the ASME Code, and therefore have margins equivalent to those of Appendix G of Section XI of the ASME Code as required by 10 CFR Part 50, Appendix G. The staff concludes that the applicant's TLAA for USE for TMI-1 RV weld materials, as given in Section 4.2.3 of the LRA is in compliance with requirements of 10 CFR Part 50, Appendix G and, therefore, is acceptable.

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that the USE analysis for TMI-1 RV weld materials has been projected to the end of the period of extended operation.

4.2.4 Pressurized Thermal Shock Limits (RTPTS) for Reactor Vessel Materials Due to Neutron Embrittlement

4.2.4.1 Summary of Technical Information in the Application

LRA Section 4.2.4 summarizes the evaluation of the unit's pressurized thermal shock (PTS) analysis for the period of extended operation. 10 CFR 50.61 defines screening criteria for the embrittlement of RV materials in pressurized water reactors (PWRs) as well as actions required if these screening criteria are exceeded. The RV reference temperature for PTS, RT_{PTS}, will increase due to increasing neutron fluence, and the screening criteria specify limits on the RT_{PTS} values. The rule requires the RT_{PTS} values for all beltline materials to be maintained below the PTS screening criteria throughout the extended period of operation. For circumferential welds, the PTS screening criterion is 300 °F. For plates, forgings, and axial welds the PTS screening criterion is 270 °F.

A PTS evaluation for the RV beltline materials was performed in accordance with 10 CFR 50.61. Calculation of RT_{PTS} values is by addition of the initial RT_{NDT}, the predicted radiation-induced change in material properties (ΔRT_{NDT}), and a margin term (m) to account for uncertainties in the values of initial RT_{NDT}, copper and nickel contents, neutron fluence, and calculation procedures. Calculation of the predicted radiation-induced ΔRT_{NDT} is by use of the respective RV beltline material copper and nickel contents and the neutron fluence applicable to the RV material through 52 EFPY of operation.

Evaluations of the RT_{PTS} values for each RV beltline material were based on the tabulated chemistry factor values given in 10 CFR 50.61.

The RT_{PTS} values for the RV beltline materials at 52 EFPY were determined and the results of the PTS evaluation demonstrated that the RV beltline materials will not exceed the PTS screening criteria before the end of the period of extended operation. The controlling RV beltline material for TMI-1 is Circumferential Weld WF-70, with an RT_{PTS} value of 263.8 °F at 52 EFPY, which is well below the PTS screening criterion of 300 °F for circumferential weld materials.

4.2.4.2 Staff Evaluation

The staff reviewed LRA Section 4.2.4 to verify, pursuant to 10 CFR 54.21(c)(1)(ii), that the analysis has been projected to the end of the period of extended operation.

10 CFR 50.61 provides the Commission's requirements for demonstrating that RVs in U.S. PWR facilities will have adequate protection against the consequences of PTS events throughout their licensed operating period. The rule requires licensees to calculate RT_{PTS} values for each base metal and weld material located in the beltline region of the RVs. The rule sets a screening limit of 270 °F for RT_{PTS} values that are calculated for base metals (i.e., forging and plate materials) and axial weld materials and a screening limit of 300 °F for RT_{PTS} values that are calculated for circumferential weld materials. The rule also provides an expanded discussion regarding how the calculations of RT_{PTS} values should be performed and describes two methods for determining RT_{PTS} values for RV beltline materials, depending on whether or not a given RV beltline material is represented in the plant's Reactor Vessel Material Surveillance Program.

The applicant provided its RT_{PTS} value assessments for the TMI-1 RV beltline materials in Table 4.2.4-1 of the LRA for TMI-1. The RT_{PTS} values listed in these tables were based on the neutron fluence values at the clad-to-base metal interface of the RV. According to Table IV A-2 of NUREG-1801, Revision 1, ferritic materials are subject to neutron embrittlement when they are exposed to a neutron fluence greater than 1×10^{17} n/cm^2 (E > 1 MeV) at the end of the extended period of operation. The applicant's neutron fluence values used to determine the RT_{PTS} values were based on the values that were projected to end of the extended period of operation (i.e., at 52 EFPY). The applicant reported that for TMI-1, Circumferential Weld WF-70 is the limiting material for PTS with a RT_{PTS} value of 263.8 °F at 52 EFPY. The initial RT_{NDT} for the Linde 80 welds was specified in BAW-2308, Rev. 2. Chemistry values were reported in BAW-1543A, Rev. 4, Supplement 4 and BAW-2325, Rev. 1. To verify the validity of the applicant's calculation of the RT_{PTS} values at 52 EFPY for TMI-1's limiting beltline materials, the staff performed independent calculations per 10 CFR 50.61 and found the RT_{PTS} values acceptable. The staff confirmed that Circumferential Weld WF-70 was the limiting beltline material for TMI-1. The staff calculated an RT_{PTS} value of 264.2°F for TMI-1 Circumferential Weld WF-70, which is in agreement with the applicant's calculation of 263.8°F, and is below the screening limit of 300°F for circumferential welds. The staff finds the RT_{PTS} values for all TMI-1 RV beltline materials to be acceptable because the bounding materials comply with the requirements specified in 10 CFR 50.61.

4.2.4.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of pressurized thermal shock limits for reactor vessel materials due to neutron embrittlement in LRA Section A.4.2.4. On the basis of its review of the UFSAR Supplement, the staff has determined that the summary description of the applicant's actions to address pressurized thermal shock limits for reactor vessel materials due to neutron embrittlement is adequate.

4.2.4.4 Conclusion

Based on the technical assessments stated above, the staff concludes that the RV's at TMI-1 will maintain acceptable RT_{PTS} values throughout the expiration of the extended period of operation. The staff therefore concludes that the applicant's TLAA for PTS, as given in Section 4.2.4 of the LRA, is in compliance with the screening criteria specified in 10 CFR 50.61. Therefore, the staff concludes that the TMI-1 RV will be acceptable for PTS through the expiration of the extended period of operation.

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that the TMI-1 RV PTS analysis has been projected to the end of the period of extended operation.

4.2.5 Reactor Vessel Operating Pressure – Temperature Limits, Including Adjusted Reference Temperatures and Low Temperature Overpressure Protection Limits

4.2.5.1 Summary of Technical Information in the Application

LRA Section 4.2.5 summarizes the evaluation of material adjusted reference temperature (ART) values and low temperature overpressurization protection (LTOP) limits for the period of extended operation. The ART is the value of a material's Initial RT_{NDT} plus ΔRT_{NDT} plus a margin term to account for uncertainties at a specific location. Neutron embrittlement increases a material's ART value; thus, the minimum temperature at which an RV is allowed to be pressurized increases over the licensed period. The ART value of the limiting beltline material is used to correct the RV beltline P-T limits to account for radiation effects.

LRA Section 4.2.5 also summarizes the evaluation of operating pressure-temperature (P-T) limits for the period of extended operation. In accordance with 10 CFR Part 50, Appendix G, P-T operating limits are specifically required for three categories of operation: (1) hydrostatic pressure tests and leak tests, (2) non-nuclear heat-up/cool-down and low-level physics tests, and (3) core critical operation. The P-T limits must be at least as conservative as limits obtained by the methods of analysis and margins of safety of Appendix G of the ASME Code, Section XI. The minimum temperature requirements pertain to the limiting material, which is either the highly stressed material in the closure flange region or a material in the beltline region with the highest ART value.

TMI-1 is currently operating to 29 EFPY P-T limit curves and LTOP limits. The applicant will submit updates to the P-T limit curves and LTOP limits prior to the period of extended operation, and prior to exceeding the 29 EFPY fluence values upon which the current P-T limits and LTOP limits are based.

4.2.5.2 Staff Evaluation

P-T limit curves are provided to specify the maximum allowable pressure as a function of reactor coolant temperature in order to prevent or minimize the effects of reduced fracture toughness caused by neutron irradiation. The curves are generated assuming that a 1/4T surface flaw exists using the fracture mechanics methodology in ASME Section XI, Appendix G. The P-T limit curves are not provided for the detection of aging effects, but rather to prevent or minimize the effects of reduced fracture toughness caused by neutron irradiation. The P-T limit curves are valid for a specified number of EFPYs. The curves must be updated before this time period is exceeded. This approach is acceptable since the validity of the curves is monitored and the P-T limit curves are updated prior to exceeding the applicable EFPY.

The staff reviewed LRA Section 4.2.5 to verify, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging on the intended function will be adequately managed for the period of extended operation. LTOP limits are considered as part of the calculation of the P-T limit curves. The current TMI-1 P-T limit curves are valid out to 29 EFPY. The applicant committed to revise the P-T limits and LTOP limits before reaching 29 EFPY and will at that time project appropriate P-T limits to the end of the 60-year licensed operating period. The RV surveillance program is in place to monitor RV embrittlement. This program will provide data to update P-T limits, and therefore will permit the licensee to manage P-T limits going forward, in accordance with 10 CFR Part 54(c)(1)(iii).

4.2.5.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of reactor vessel operating pressure – temperature limits, including adjusted reference temperatures and low temperature overpressure protection limits in LRA Section A.4.2.5. On the basis of its review of the UFSAR Supplement, the staff has determined that the summary description of the applicant's actions to address reactor vessel operating pressure – temperature limits, including adjusted reference temperatures and low temperature overpressure protection limits is adequate.

4.2.5.4 Conclusion

On the basis of its review, as discussed above, the staff concluded that the applicant has demonstrated, that for P-T limits and LTOP PORV setpoints, the analyses are current and have been projected to 29 EFPY. The applicant has committed to revise the P-T limits and LTOP PORV setpoints for the period of projected operation, which satisfies Appendix G of 10 CFR Part 50; and 10 CFR 54.21(c)(1)(iii).

4.2.6 Neutron Embrittlement of Reactor Vessel Internals

4.2.6.1 Summary of Technical Information in the Application

LRA Section 4.2.6 summarizes the evaluation of changes in the properties of the stainless steel and nickel-based alloys used in RV internals resulting from exposure to high-energy neutrons (E > 1.0 MeV). This neutron irradiation can result in changes to the RV mechanical properties, including a decrease in the ductility and fracture toughness of RV internals materials. The degree of neutron embrittlement is a function of the irradiation temperature and neutron fluence. Generally, RV internals components closest to the core experience the greatest extent of neutron embrittlement.

The effects of neutron embrittlement on the RV internals were evaluated for the current licensing basis in topical report BAW-10008, Revision 1, Appendix E. The analysis concluded that at forty years, the internals will maintain adequate ductility to absorb local strain at the regions of maximum stress intensity, and that neutron irradiation will not adversely affect deformation limits.

The applicant states that the analysis of neutron embrittlement of RV internals is a TLAA that will be managed by the PWR Vessel Internals program for the period of extended operation.

4.2.6.2 Staff Evaluation

The staff reviewed LRA Section 4.2.6, pursuant to 10 CFR 54.21(c)(1)(iii). The applicant stated that changes in mechanical properties of RV internals due to neutron embrittlement will be managed through the following activities of the PWR Vessel Internals program: (1) participating in the industry programs for investigating and managing aging effects on reactor internals, (2) evaluating and implementing the results of the industry programs as applicable to the RV internals, and (3) submitting an inspection plan for reactor internals to the NRC, for review and approval, not less than 24 months before entering the period of extended operation.

4.2.6.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of neutron embrittlement of reactor vessel internals in LRA Section A.4.2.6. On the basis of its review of the UFSAR Supplement, the staff has determined that the summary description of the applicant's actions to address neutron embrittlement of reactor vessel internals is adequate.

4.2.6.4 Conclusion

Based on the applicant's commitment (Appendix A of the LRA, Commitment No. 36) to manage the effects of the aging of RV internals due to neutron embrittlement through participation in the PWR Vessel Internals Program, the staff concludes that the applicant can adequately manage the aging of RV internals due to neutron embrittlement for the period of extended operation.

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(iii), that the applicant's processes will adequately manage the TMI-1 effects of aging of RV internals due to neutron embrittlement.

4.3 Metal Fatigue of Piping and Components

A metal component that is subjected to cyclic loads may fail at load levels lower than its design load carrying capacity due to a well-known phenomenon known as fatigue failure. Fatigue failure involves crack initiation and propagation. The fatigue life of a structural component depends on the material used for the structure, the environment to which the structural component is exposed, the number of occurrences or repetitions and magnitude of the applied fluctuating loads.

In LRA Section 4.3, the applicant states that metal fatigue was evaluated in the design process for pressure-retaining components, including the reactor pressure vessel, reactor coolant pumps, steam generators, pressurizer, piping, valves, and components of primary, secondary, auxiliary, steam, and other systems. The applicant further states that metal fatigue was also evaluated in the design of the reactor vessel internal components and the design analyses for these components have been determined to be TLAAs requiring evaluation for the period of extended operation. Furthermore, the applicant states that fatigue TLAAs for pressure boundary components are characterized by determining the applicable design codes and specifications that specify the fatigue design requirements.

Fatigue is age-related degradation caused by cyclic stressing of a component by either mechanical or thermal stresses. Fatigue analyses are TLAAs if they meet the six defined elements pursuant to 10 CFR 54.3(a). If the analyses are based on a number of cycles estimated for the current license term, they may meet the 10 CFR 54.3(a)(3) criterion of "defined by the current operating term." The applicant evaluates the TLAA in accordance with 10 CFR 54.21(c)(1) to determine which of the following conditions are demonstrated:

(i) The analyses remain valid for the period of extended operation;

(ii) The analyses have been projected to the end of the period of extended operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the period of extended operation

4.3.1 Evaluation of Fatigue in ASME Class 1 and USAS B31.7 Piping and Components

4.3.1.1 Summary of Technical Information in the Application

LRA Section 4.3 states that fatigue analyses are potential TLAAs for Class 1 and for selected non-Class 1 pressure boundary components. The applicant further states that most of the key components of the reactor coolant pressure boundary (RCPB) were designed to the requirements for Class 1 components found in ASME B&PV Code, Section III, and that only a few components were designed to the USA Standard (USAS) B31.7.

LRA Table 4.3.1-1 shows the design codes used for each of the pressure-retaining components, and LRA Table 4.3.1-2 shows the monitored design transients and cycles. In LRA Section 4.3.1, the applicant states that each component designed in accordance with ASME Section III, Class A or Class 1 rules or in accordance with USAS B31.7 rules was shown to have a cumulative usage factor less than or equal to the design limit of 1.0.
The applicant further states that it has performed evaluations for unanticipated transients that were not considered in the original design. The applicant notes that the unanticipated transients include thermal stratification cycles and thermal striping of piping in the RCS system and insurge/outsurge transients associated with operation of the pressurizer and pressurizer surge line. The applicant also indicates that these components will be monitored under the Fatigue Monitoring Program described in LRA Section B.3.1.1 and the functional specifications have been revised accordingly. The applicant indicates that these revised analyses reflect the current design basis and resulted in CUF values less than or equal to 1.0.

Furthermore, the applicant indicates that it also has revised fatigue analyses for the High Pressure Injection (HPI) nozzles due to modifications in the testing procedures. These revised analyses reflect the current design basis (40-year transients) and the revised CUF values were shown to be within the limit of 1.0.

The applicant performs TLAA evaluations to determine whether the cumulative fatigue usage (CUF) is within the limit of 1.0 at the end of the period of the extended operation and the applicant monitors those transients that are significant contributors to fatigue usage to assure that the limits are not exceeded. To determine whether extending operation from 40 to 60 years is feasible, the applicant first attempted to multiply the 40-year design CUF values of the structural components by a factor of 1.5, ratio of 60 to 40, and found that three of all the components evaluated, as identified below, would have the 60-year projected CUF values exceeding the limit of 1:

(1) RV Outlet Nozzle
(2) Core Flood Venturi
(3) Pressurizer Spray Line Piping

The LRA states that fatigue of all Class 1 components will be managed using the Metal Fatigue of Reactor Coolant Pressure Boundary Program, pursuant to 10 CFR 54.21(c)(1)(iii), to assure that fatigue usage does not exceed the 1.0 limit during the period of the extended operation.

4.3.1.2 Staff Evaluation

The staff reviewed LRA Section 4.3.1 to verify, pursuant to 10 CFR 54.21(c)(1)(iii), that the fatigue of these components will be adequately managed for the period of extended operation.

Since not all TLAAs will remain valid for 60-years if subject to 1.5 times the number of design transients, TMI-1 will manage fatigue of all Class 1 components using the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program. The staff finds the applicant's disposition, pursuant to 10 CFR 54.21(c)(1)(iii), acceptable because it is consistent with the GALL Report. However, further evaluation must be performed to determine appropriate transient cycle administrative limits that will be used to assure that these components satisfy the fatigue requirements during the period of the extended operation. The new transient cycle administrative limits will replace the transient design cycles as limits for those components that would otherwise fail to meet the fatigue requirements.

The staff notes that since the transient types and environments remain unchanged for an operating plant, the value of CUF for any structural component depends on the cycles that the plant actually experienced. The staff notes that the Metal Fatigue of Reactor Coolant Pressure Boundary Program relies on transient cycle monitoring to assure meeting the fatigue requirement during the period of the extended operation and this approach tracks the number of occurrences of significant thermal and pressure transients (significant events) and compares the cumulative cycles against the number of design cycles specified in the design specifications (or against the administrative cycles specified in the Metal Fatigue of Reactor Coolant Pressure Boundary Program). The applicant uses the projected cycles to evaluate the total cumulative usage factor for 60-years. The staff also notes that for this approach to work, none of the significant events tracked should produce stresses greater than those that would be produced by the design transients. Namely, the P-T characteristics, including their values, ranges, and rates, all must be bounded within those defined in the design specifications. During the AMP audit, the staff determined that the applicant did not provide this information in the Metal Fatigue of Reactor Coolant Pressure Boundary Program. In RAI B.3.1.1-1, dated September 29, 2008, the staff requested that the applicant provide additional information to justify that the monitored transient data remain bounded by those defined in the design specifications.

In its response to the RAI dated October 20, 2008, the applicant stated that in order to assure that the tracked events do not produce stresses greater than those produced by the design transients, the plant fatigue monitoring procedure provides detailed design transient descriptions and bases for review by control room operators during the logging of a transient. The applicant further stated that the fatigue monitoring procedure requires the fatigue monitoring engineer to review the plant operating logs semiannually and whenever an unusual reactor operating event occurs that would require abnormal coolant injections. A more detailed discussion can be found in SER Section 3.0.3.2.25.

Based on its review, the staff finds the applicant's response to RAI B.3.1.1-1 acceptable because the operational procedures that the applicant adopts for the transient events tracking are consistent with the GALL Report and conservative to ensure a valid cycle-based fatigue management program. Therefore, the staff's concern described in RAI B.3.1.1-1 is resolved.

4.3.1.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of ASME Class 1 and USAS B31.7 piping and component fatigue analysis in LRA Section A.4.3.1. On the basis of the review of the UFSAR Supplement, the staff concludes that the summary description of the applicant's actions to address ASME Class 1 and USAS B31.7 piping and component fatigue analysis is adequate.

4.3.1.4 Conclusion

On the basis of its review, the staff concludes, pursuant to 10 CFR 54.21(c)(1)(iii), that the applicant has demonstrated that the effects of aging of the intended functions will be adequately managed during the period of extended operation. The staff also concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.3.2 Evaluation of Reactor Water Environmental Effects on Fatigue Life of Piping and Components (Generic Safety Issue 190)

LRA Section 4.3.2 discusses the evaluation of the effects of the reactor coolant environment on fatigue life of components and piping, Generic Safety Issue (GSI)-190, "Fatigue Evaluation of Metal Components for 60-Year Plant Life," for the period of extended operation. ASME Section III uses stress versus allowable cycle curves (S-N curves) based on tests in air to determine a fatigue usage factor. GSI-190 addresses the effects of the reactor coolant environment on fatigue life of components and piping. The unfavorable environment can significantly shorten the fatigue life of stressed components.

4.3.2.1 Summary of Technical Information in the Application

LRA Section 4.3.2 discusses the environmental fatigue evaluations for the RCS piping and components. The analyses were performed based on the guidelines given in GALL AMP X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary." The applicant stated that the GALL Report contains recommendations on specific areas for which existing programs should be augmented for license renewal. The applicant further states that sample critical components applicable to Babcock and Wilcox plants are identified in NUREG/CR-6260, "Application of

NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components," March 1995, as follows:

1a. Reactor vessel - shell
1b. Reactor vessel - lower head
2a. Reactor vessel - inlet nozzles
2b. Reactor vessel - outlet nozzles
3. Pressurizer surge line
4. High Pressure Injection/Makeup (HPI/MU) nozzle
5. Reactor vessel - core flood nozzle
6. Decay heat removal system piping (decay heat return line/core flood tee)

The applicant stated that the sample components can be evaluated by applying environmental life correction factors to the existing ASME Code fatigue analyses using formulas contained in NUREG/CR-6583, "Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels," and in NUREG/CR-5704, "Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels." The applicant also stated that the methodology used to compute the environmental correction factor for nickel-alloy materials was based upon the paper entitled "Status of Fatigue Issues at Argonne National Laboratory," presented by Omesh K. Chopra at the EPRI Conference on Operating Nuclear Power Plant Fatigue Issues & Resolutions, August 1996.

The applicant stated that demonstrating that these components have an environmentally adjusted cumulative usage factor less than or equal to the design limit of 1.0 is an acceptable option for managing metal fatigue for the reactor coolant pressure boundary. The applicant performed environmental fatigue analyses for each of the locations listed above. The first step that the applicant took was to determine the environmentally assisted fatigue (EAF) correction factor, F_{en}, based on the guidance from the applicable NUREG for the material types (stainless steels or carbon/low alloy steels) and Chopra's report for nickel-alloys. The second step was to multiply these F_{en} factors by the design fatigue usage values of the corresponding structural components/locations. The applicant further multiplied the products by a factor of 1.5, the ratio of 60-year to 40-year, to account for the increased cycles for the period of extended operation. The final value is the EAF-adjusted CUF value of a structural component at the end of the period of extended operation.

In the initial environmental fatigue calculations the applicant identified four locations that would have the EAF-adjusted CUF values greater than 1.0 at the end of the period of extended operation. These locations are as follows:

(1) Reactor Vessel Lower Head at Instrument Nozzle Penetration Weld
(2) Reactor Vessel Outlet Nozzle
(3) Pressurizer Surge Line (elbow)
(4) Makeup/High Pressure Injection Nozzle

The applicant stated that to assure that these components will not exceed an EAF-adjusted CUF value of 1.0 during the period of extended operation, the Metal Fatigue of Reactor Coolant Pressure Boundary Program is adopted, pursuant to 10 CFR 54.21(c)(1)(iii), to manage environmental fatigue of each Class 1 component. The applicant stated that to achieve this goal, it is necessary to establish appropriate new transient cycle administrative limits that will replace the transient design cycles as limits for the affected components in the Metal Fatigue of Reactor Coolant Pressure Boundary Program.

Based on the projected cycles, the applicant indicated that all locations listed in this section have an EAF-adjusted CUF value within the limit of 1.0.

4.3.2.2 Staff Evaluation

The staff reviewed LRA Section 4.3.2 to verify, pursuant to 10 CFR 54.21(c)(1)(iii), that the analyses remain valid for the period of extended operation.

As discussed in SER Section 4.3.2.1, the applicant relies on new transient cycle administrative limits to support its LRA. The staff noted that reestablishing the transient cycle administrative limits requires transient cycle monitoring and counting. The applicant used plant operating history, analyzed the data and established a basis to find the average rate for each transient over a period of time. The applicant projects the 60-year transient cycles based on the average transient occurrence actually accrued from the plant startup (April 19, 1974) through December 31, 2006. The applicant noted that there are 26.7 years in this baseline period since it excludes the 6 years (1979 to 1985), in which TMI-1 was shutdown due to the TMI-2 incident. The staff performed hand calculations to verify the results presented in LRA Table 4.3.2-3 and found that the 60-year cycle projection for each transient was obtained by multiplying the average event rates by 54. During the AMP audit, the staff asked why 54 instead of 60 years was used for the projections and the applicant responded that TMI-1 will have operated a total of 54 years when the renewed license expires. The staff finds this response acceptable because 54 years will be the total time that TMI-1 will have actively operated (based on original license term plus the renewal term and deducting the extended shutdown period) and thus, the projection should be made based on 54 years rather than for 60 years of operation.

The applicant indicated that to qualify for the fatigue requirements for the surge line environmental fatigue analyses, refinement on cycle projection for the heatup/cooldown transients is necessary. The applicant used three different methods to estimate the average event occurrence rate:

(1) Averaging based on data accrued from the plant startup through December 31, 2006. The applicant indicated that since there is a 6-year shutdown period, the averaging involves two base periods: Base period A: April 19, 1974 – March 29, 1979 (5 years) and Base period B: April 10, 1985 – December 31, 2006 (21.7 years). There are 25 cycles accrued in base period A and 24 cycles accrued in the base period B. The applicant thus determined the average event rate being (25+24)/(5+21.7) = 1.835 per year, and projected the future cycles (January, 2007 through April, 2034, 27.3 years) being 1.835*27.3 = 50 cycles. Adding to it the 49 cycles from the baseline period (plant startup through December 31, 2006) results in 99 cycles. The staff performed hand calculations and confirmed the results presented in LRA Table 4.3.2-4. The staff noted that this method is exactly the same as the method described in the preceding paragraph.

(2) Averaging based on data accrued between April 10, 1985 and December 31, 2006.

For this method the applicant dropped base period A and used the data from base period B alone. The applicant determined the average event rate being 24/21.7 = 1.106 per year, and projected the future cycles (January, 2007 through April, 2034, 27.3 years) being 1.106*27.3 = 30 cycles. Adding to it the 49 cycles from the baseline period (plant startup through December 31, 2006) results in 79 cycles. The staff performed hand calculations and confirmed the results presented in LRA Table 4.3.2-4. The applicant slightly rounded up the results to 80 cycles and indicates that 80 cycles of heatup and cooldown transients were used for the revised fatigue evaluations for the surge line environmental fatigue analysis. The applicant stated that the first five year's data should be excluded from the averaging process because adjustments were involved in the initial stage of the plant operation and the situation gradually stabilized thereafter.

(3) Averaging based on data accrued between January 1, 1997 and December 31, 2006. For this method the applicant considered only the last 10 years of base period B. The applicant indicated there were 7 heatup/cooldown events accrued. The applicant determined the average event rate being 7/10 = 0.7 per year, and projected the future cycles (January, 2007 through April, 2034, 27.3 years) being 0.7*27.3 = 20 cycles (the applicant rounded it up from 19.11). Adding to it the 49 cycles from the baseline period (plant startup through December 31, 2006) results in 69 cycles. The staff performed hand calculations and confirmed the results presented in LRA Table 4.3.2-4.

The staff evaluated the above methods, as described below:

Of the three methods the applicant presented, Method 2, which the applicant selected for supporting its license renewal application, was deemed most reasonable. Herein the staff evaluated the validity of Method 2. From sample size viewpoint, Method 2 covers 81% of the time window (21.6 of the 26.7 years) as it excludes the first 5 years. It is understood that the portion of the time that is excluded has the highest instantaneous event occurrence rate and so it may raise concerns for underestimating. However, the staff noted that several other aspects about Method 2 should be considered, as described below:

(a) 81% of time window coverage is significant for building a basis for making creditable predictions by any standard.

(b) The portion of time that is excluded is the first 5 years after the plant initial startup. In the initial stage of any complex process, a learning curve is often unavoidable and associated procedural adjustments may be required until a comfortable level is established.

(c) The transient occurrence rate obtained from this method (and the other 2 methods as well) was only used for predicting the cycles that would occur in the future. The baseline cycles (49), which is to be added to the projected future cycles, have included those cycles that occurred in the first 5 years.

Based on its review and evaluation described above, the staff finds the applicant's selection of Method 2 to make the 60-year cycle projection for heatup/cooldown transients (for surge line components) acceptable for the following reasons:

(a) Method 2 produced a reasonable transient occurrence rate, 1.106 per year, which gives a good margin towards the standard refueling rate of 0.67 per year. The margin is 8 events over 20 years, as calculated by (1.106 - 0.67)x20 = 8.7 → 8.

(b) Although Method 1 is based on the all-time data, it will keep the pressurizer surge line locations from meeting the environmental fatigue requirements. Method 3 produced a very aggressive event occurrence rate, 0.7 per year, so aggressive that it matches the standard refueling rate (0.67 per year) and leaves no room for errors. In other words, Methods 1 and 3 are not viable.

For the HPI/MU nozzle (High Pressure Injection/Makeup Nozzle), the applicant divides the fatigue usage into three portions: (1) the portion that is due to the valve test cycles; (2) the portion that is due to HPI non-test actuation cycles; and (3) the portion that is due to 40-year design numbers of Reactor Trip and Rapid RCS Cooldown cycles. The staff finds such a division acceptable because it is for administrative purposes and for reasons described below. The applicant indicates that the HPI valve testing method was revised in 2001, after 35 occurrences, by performing the test during outages when the reactor head is removed. Therefore, after 2001, the valve testing involves no thermal effects. Previously, the valve testing was performed while the plant was running. Thus, after the testing method revision, fatigue due to the valve tests would be negligible and no longer will there be environmental fatigue effects associated with the valve tests. As for the HPI non-test actuation transient, the original administrative cycle limit, 59, would keep the HPI/MU nozzle from meeting the environmentally assisted fatigue requirements. Therefore, to meet the fatigue requirement during the period of the extended operation, monitoring for the HPI non-test actuation transient is required. The applicant states that only 3 non-test HPI actuation cycles occurred during the baseline period (26.7 years) and it is projected that a total of 6 cycles will occur for 60 years of plant operation. The applicant sets the HPI non-test transient new administrative cycle limit to 35. The staff finds this is acceptable because the environmentally assisted fatigue factor at the HPI/MU nozzle will be within the limit of 1.0 based on this administrative cycle limit, which bounds the projected 60-year cycles of 6.

The applicant indicated that the operation of the power change transients (0% - 15% power and 15% - 0% power) is associated with recovery from reactor trip, turbine trips, and step load reduction (100% to 8% Power) events. The applicant also indicates that the power change transients are not currently tracked but the administrative limit is reduced to 480 cycles from 1440 for the surge line environmental fatigue analyses. The staff finds the 480 cycles of administrative limitation for the power change transients reasonable because the total of projected 60-year cycles of reactor trips and step load reduction altogether is estimated to be 4+75+43=122. See LRA Table 4.3.2-3. The estimate is acceptable because (1) the power change transients are triggered by the reactor trips and step load reduction events, and (2) the estimated cycles, 122, is well bounded by the 480 cycles that is used for the new administrative cycle limit for this particular transient.

LRA Section 4.3.2, (in the last sentence of the third paragraph under the section titled *"Reduced Transient Cycle Administrative Limits – Pressurizer Surge Line")*, states the following: The F_{en} environmental correction factors shown are the overall average for each analysis. The staff determined that additional information regarding this statement was required because it could mean the average of F_{en} of all of the transients together for a single location, or the two-way average of F_{en} of all of the transients together and of all locations having the same material. The staff notes that since fatigue is localized damage, cross-location averaging of F_{en} values is inappropriate and would lead to non-conservative fatigue usage predictions. In RAI 4.3.2-1, dated September 30, 2008, the staff requested that the applicant provide additional information to clarify the environmental correction factors.

In its response to the RAI, dated October 23, 2008, the applicant stated that the phrase "overall average for each analysis" means the average F_{en} correction factor (or multiplier) for all of the transients together for a single location, and points out that the phrase "overall average" applies to the results from the refined fatigue analyses for Locations 3a and 3b in Table 4.3.2-2 of the LRA. The applicant also stated that in the analyses of these two locations, an individual F_{en} correction factor was computed for selected load set ranges (transient parings) based upon the equations provided in Section 4.1 of EPRI MRP-47, Revision 1 and that each individual F_{en} factor was computed using only data appropriate for the location and for the transient pairing. The applicant stated that no multiple locations averaging were involved.

The staff reviewed EPRI report MRP-47, Revision 1, to verify validity of the equations that the applicant used, as indicated in its response to RAI 4.3.2-1, for its environmental fatigue calculations and confirmed that MRP-47 uses the same algorithms recommended in NUREG/CR-6583 for carbon steels and low alloy steels and in NUREG/CR-5074 for austenitic stainless steels.

The applicant further indicated that the values reported as F_{en} factors in Table 4.3.2-2 are a composite of the overall average F_{en} for the fatigue analysis and cycle reduction factor, and are computed by dividing the EAF-adjusted CUF value of the component by the current design CUF value of the component.

Based on its review, the staff finds the applicant's response to RAI 4.3.2-1 acceptable because the EAF-adjusted analyses were performed based on EPRI MRP-47 which involves no multi-location interaction. The applicant determined F_{en} factors individually, for each transient pair in the computing process and obtained the partial EAF-adjusted CUF. The applicant took the summation to obtain the total EAF-adjusted CUF value contributed by all transients. The staff notes that the F_{en} values shown in Column labeled "F_{en} Correction Factor" LRA Table 4.3.2-2 may be considered as equivalent-F_{en} values, obtained by dividing the values under Column labeled "Environmental CUF" by the corresponding values under Column labeled "Inside Surface CUF."

The staff notes that the data shown in the column labeled "Inside Surface CUF" are 40-year design CUF values. However, as shown in LRA Tables 4.3.2-3 and 4.3.2-4, since the 40-year design cycles are greater than the projected 60-year cycles, determining the 60-year EAF-adjusted CUF by multiplying the 40-year design CUF value by the corresponding equivalent F_{en} value is conservative.

On the basis of the staff's review as described above, the staff's concern of the F_{en} factor averaging method as described in RAI 4.3.2-1 is resolved because there was no cross location or multiple location averaging involved. The staff's concern described in RAI 4.3.2-1 is resolved. Additionally, as shown in LRA Tables 4.3.2-1 and 4.3.2-5 and some intermediate tables, a single value of F_{en} is used for the low alloy steel, disregarding the locations/components that they are associated with. The same situation is seen for the locations which use Alloy 600 material. However, F_{en} is a function of strain rate, dissolved oxygen concentration, and temperature. As a result, a F_{en} factor is expected to be different for each location because strain rates are likely to be different for each component and location. In RAI 4.3.2-2, dated

September 30, 2008, the staff requested that the applicant provide additional information to clarify the strain rates.

In its response to the RAI dated October 23, 2008, the applicant stated that maximum F_{en} values were computed for each material type by using bounding assumptions for each input variable in the applicable F_{en} equations. These maximum F_{en} values were used as a first attempt to qualify each of the NUREG/CR-6260 locations for environmental fatigue effects. The applicant obtained the maximum F_{en} values for carbon steel, low alloy steel, austenitic stainless steel, and nickel alloy 600 as 1.74, 2.455, 15.35, and 1.49, respectively. The maximum F_{en} approach, in combination with reduced numbers of transient cycles, was successful for qualifying each location except Locations 3a and 3b. Refined fatigue evaluations were performed for these two locations, where individual F_{en} factors were computed and utilized as described in the response to RAI 4.3.2-1.

The staff finds the applicant's response to RAI 4.3.2-2 acceptable because the applicant used the maximum F_{en} value for its environmental fatigue adjustment. The maximum F_{en} values for each of the applicable materials can be calculated using equations in NUREG/CR-6583 for carbon steels and low alloy steels and in NUREG/CR-5074 for Austenitic stainless steels. The staff performed hand calculations to verify the maximum F_{en} values. The staff notes that the maximum F_{en} values for carbon steels and low alloy steels (1.74, 2.455, respectively) from the applicant's response to the RAI, involves an assumed DO (dissolved oxygen) concentration level of 0.05 ppm. For stainless steels, the maximum F_{en} (15.35) requires a temperature T > 200 °C, strain rates $\dot{\varepsilon}$ less than 0.0004% per second, and DO levels less than 0.05 ppm. In a letter dated April 29, 2009 the applicant confirmed that the assumed dissolved oxygen value of less than 0.05 ppm is the bounding value. The applicant stated that during power operations in the last three operating cycles, the measured dissolved oxygen concentration has normally been less than 0.005 ppm and has not exceeded 0.027 ppm.The applicant further stated that a sampling of data for the period 1974 – 1979 identified that the dissolved oxygen concentration in the reactor coolant during power operations was less than 0.050 ppm. The maximum F_{en} value of 1.49 for Nickel Alloy 600 can be found in the paper entitled "Status of Fatigue Issues at Argonne National Laboratory," presented by Omesh K. Chopra at the EPRI Conference on Operating Nuclear Power Plant Fatigue Issues & Resolutions, August 1996. The staff notes that the EPRI technical information (presented by Omesh K. Chopra) quoted herein for Alloy 600 F_{en} calculations can be found in NUREG/CR-6335, titled "Fatigue Strain-Life Behavior of Carbon and Low-Alloy Steels, Austenitic Stainless Steels, and Alloy 600 in LWR Environments," authored by J. Keisler, O. K. Chopra, and W. J. Shack, dated August 1995. On the basis of the staff's review as described above, the staff's concern described in RAI 4.3.2-2 is resolved.

The staff noted that the applicant made corrections to the LRA after it was submitted on January 8, 2008. On April 8, 2008, the applicant informed the staff of corrections by submitting a supplement, titled "Corrections to the Three Mile Island Nuclear Station Unit 1 License Renewal Application." One of the areas identified in the LRA supplement is applicable to the environmental fatigue TLAA, as discussed below:

> Affected Section: 4.3.2 – Evaluation of Reactor Water Environmental Effects on Fatigue Life of Piping and Components (Generic Safety Issue 190)
>
> LRA Page Numbers: 4-32, 4-33 and 4-38
>
> Tables: Table 4.3.2-2, TMI-1 Pressurizer Surge Line Environmental Fatigue Results

Table 4.3.2-5, Final Environmental Fatigue Analysis Summary for NUREG/CR-6260 Locations

Change: This change incorporates updated analysis results for environmental fatigue of pressurizer surge line nozzles and safe ends (locations 3c and 3d). All environmentally adjusted cumulative usage factor (CUF) values remain acceptable, below the code limit of 1.0 for 60 years

The staff reviewed the environmental fatigue TLAA portion of the LRA supplement. The applicant stated that none of the corrections involve design base changes except that 40-year cycles instead of the reduced cycles are now used for calculating the CUF for the hot leg nozzle safe end. The applicant noted that this was done for consistency purposes so that all of the analyzed locations associated with the nozzles, safe ends, and weld overlays are based upon the same number of transient cycles, which is the 40-year design numbers. The staff noted that this is conservative because larger cycles are used for the analyses. Another facet indicated in the LRA supplement concerns the EAF correction factor or multiplier, F_{en}, in which the value 1.74 is now used, replacing 2.455, for the hot leg nozzle and pressurizer surge nozzle, both of which are carbon steel materials. The staff noted that 2.455 is the maximum F_{en} value applicable to low alloy steels, whereas 1.74 is the maximum F_{en} value for carbon steels. The staff noted that the modification is appropriate because now the location under consideration is evaluated based on the actual material used for the location, carbon steel. The applicant stated that the final EAF-adjusted CUF values for Locations 3c and 3d are now greater than those shown in the original LRA but still are within the acceptable limit of 1.0. The corrected Table 4.3.2-5, which shows the EAF-adjusted CUF for the NUREG/CR-6260 locations, is reproduced below.

Enclosure A
Corrections in the Main Body of the TMI Unit 1 LRA

Table 4.3.2-5 Final Environmental Fatigue Analysis Summary for NUREG/CR-6260 Locations

Location No.	Component	Limiting Material Type	Inside Surface CUF	Fen Multiplier	EAF Adjusted CUF	P/F
1a	Reactor Vessel Shell and Lower Head - Lower Head near Support Skirt	Low Alloy Steel	0.004	2.455	0.010	Pass
1b	Reactor Vessel Lower Head – Instrument Nozzle Penetration Weld	Nickel Alloy 600	0.564	1.49	0.840	Pass
2a	Reactor Vessel Inlet Nozzle	Low Alloy Steel	0.008	2.455	0.020	Pass
2b	Reactor Vessel Outlet Nozzle	Low Alloy Steel	0.252	2.455	0.619	Pass
3a	Pressurizer Surge Line (elbow)	Stainless Steel	0.399	2.383	0.951	Pass
3b	Surge Line – Piping Non-Elbow bounding pipe location	Stainless Steel	0.375	2.259	0.847	Pass
3c	Safe End	Stainless Steel	***0.063*** ~~0.0358~~	15.35	***0.967*** ~~0.550~~	Pass
3d	Pressurizer Surge Nozzle ~~Forging~~	Carbon Steel	***0.3909*** ~~0.0056~~	***1.74*** ~~2.455~~	***0.680*** ~~0.0137~~	Pass
4	Makeup/High Pressure Injection Nozzle	Nickel Alloy 600	0.656	1.49	0.977	Pass
5	Reactor Vessel Core Flood Nozzle	Low Alloy Steel	0.198	2.455	0.486	Pass
6	Decay Heat Removal System Return Line Class 1 Piping	Stainless Steel	0.0213	15.35	0.327	Pass

Based on its review, the staff finds the LRA supplement acceptable because the changes result in the analyses being more conservative.

4.3.2.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA on effects of reactor water environmental effects on fatigue life of components and piping (GSI-190) in LRA Section A.4.3.2. On the basis of the review of the UFSAR Supplement, the staff concludes that the summary description of the applicant's actions to address effects of reactor water environmental effects on fatigue life of components and piping (GSI-190) is adequate.

4.3.2.4 Conclusion

The staff concludes that the applicant's selecting of Method 2 to make the 60-year cycle projection for heatup/cooldown transients (for surge line components) is acceptable.

On the basis of its review, including the applicant's responses to the RAIs, and the corrections to the LRA, the staff concludes that, pursuant to 10 CFR 54.21(c)(1)(iii) the applicant has demonstrated that the effects of regarding reactor water environmental effect on fatigue life of piping components would be adequately managed for the period of extended operation. The staff also concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.3.3 ASME Class 2 and 3 and USAS B31.1 Piping and Component Fatigue Analysis

4.3.3.1 Summary of Technical Information in the Application

LRA Section 4.3.3 states that piping designed in accordance with ASME Section III Class 2 or 3 rules, or with the USAS B31.1 Piping Code was not required to have an analyses of cumulative fatigue usage, but effects of fatigue were considered in a simplified manner in the design process. The fatigue requirement is satisfied if the total number of thermal cycles from all transients expected during the 40-year lifetime of these components is within the 7,000-cycles. If the 7,000-cycle limit is exceeded, appropriate stress range reduction factors must be applied to the allowable stress range for secondary stresses to account for thermal cycling.

The applicant concluded based upon the transient projection results discussed in LRA Section 4.3.3, that the numbers of cycles expected to occur in 60-years will not exceed the 7,000-cycle limit and the fatigue requirements for the Class 2 and 3 components will be satisfied during the period of extended operation, pursuant to 10 CFR 54.21(c)(1)(iii).

4.3.3.2 Staff Evaluation

The staff reviewed LRA Section 4.3.3 to verify, pursuant to 10 CFR 54.21(c)(1)(iii), that the fatigue of these components will be adequately managed for the period of extended operation.

The staff noted that no explicit fatigue evaluation is required for Class 2 and 3 components designed according to ASME III or USAS 31.1 Codes. Furthermore, for Class 2 and 3 components, the fatigue requirement is met if the total number of cycles of all transients for these structural components experienced during the license term is kept within 7,000-cycles. LRA Section 4.2 shows that all transients that are tracked have 60-year projected cycles fewer than the total number of cycles used in the original piping design. The staff noted that Class 2 and 3 components are associated mostly with heatup/cooldown transients, which are limited to 240 cycles. As per LRA Table 4.3.2-3, adding all cycles applicable to Class 1 components, the projected 60-year cycles are well below the 7,000 cycle limit, noting that steady state fluctuations and load/unload cycles would not be applicable to Class 2 and 3 piping. Based on its review, the staff finds the applicant's claim that TMI-1 Class 2 and 3 components will continue to meet the fatigue requirements during the period of extended operation, acceptable.

4.3.3.3 UFSAR Supplement

The applicant provided an UFSAR Supplement summary description of its TLAA evaluation for ASME Class 2 and 3 and USAS B31.1 piping and component fatigue analysis in Section A.4.3.3 of the LRA. On the basis of the review of the UFSAR Supplement, the staff concludes that the summary description of the applicant's actions to address ASME Class 2 and 3 and USAS B31.1 piping and component fatigue analysis is adequate.

4.3.3.4 Conclusion

On the basis of the review of the LRA the staff concludes that the applicant has demonstrated pursuant to 10 CFR 54.21(c)(1)(iii) that the effects of aging regarding ASME Class 2 and 3 and USAS B31.1 piping and components will be adequately managed for the period of extended operation. The staff also concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.3.4 Reactor Vessels Internals Fatigue Analysis

4.3.4.1 Summary of Technical Information in the Application

LRA Section 4.3.4 discusses the fatigue analyses for reactor vessel internals and states that the RV internals were designed and constructed prior to the development of ASME Code requirements for core support structures. The applicant stated that the design of the RV internals had followed the reactor coolant system functional design requirements and that the RV internals were implicitly designed for low cycle fatigue based upon the reactor coolant system design transient projections for 40 years, which has been identified as a TLAA.

The applicant indicated that the cycles of the original design transients will be used as limits in the Metal Fatigue of Reactor Coolant Pressure Boundary Program, in accordance with 10 CFR 54.21(c)(1)(iii), which monitors transient cycles to assure they do not exceed their design limits.

4.3.4.2 Staff Evaluation

The staff reviewed LRA Section 4.3.4 to verify, pursuant to 10 CFR 54.21(c)(1)(iii), that the fatigue of these components will be adequately managed for the period of extended operation.

The design transient cycles shown in LRA Table 4.3.1-2 were implicitly used in the original design of the reactor vessel internals to determine qualification of the fatigue requirements. LRA Tables 4.3.2-3 and 4.3.2-4 contain the results of projected 60-year cycles. The staff notes that while the cycles shown in these tables were intended for addressing environmental fatigue, the results show that the projected 60-year cycles are bounded by the 40-year design cycles shown in Table 4.3.1-2 for all transients. Based on its review, the staff finds the applicant's approach of using the original design cycles as limits in the Metal Fatigue of Reactor Coolant

Pressure Boundary Program, pursuant to 10 CFR 54.21(c)(1)(iii), acceptable because the design analyses meet the fatigue requirements based on the original transient design cycles, which bound the 60-year projected cycles.

4.3.4.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of the TLAA evaluation of reactor vessel internals fatigue in LRA Section A.4.3.4. On the basis of the review of the UFSAR Supplement, the staff concludes that the summary description of the applicant's actions to address reactor vessel internals fatigue is adequate.

4.3.4.4 Conclusion

On the basis of the review of the LRA, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging regarding RV internals fatigue analysis will be adequately managed for the period of extended operation. The staff also concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.3.5 Reactor Vessel Internals Flow-Induced Vibration Analysis

4.3.5.1 Summary of Technical Information in the Application

LRA Section 4.3.5 discusses reactor vessel internal flow-induced vibration (FIV) evaluations and identified it as a TLAA. The applicant stated that the components analyzed included the stainless steel incore instrumentation nozzles, the incore instrumentation guide tubes, the flow distributor, the flow distributor assembly support plate, the thermal shield, the inlet baffle, and bolting. The applicant also stated that these components are austenitic stainless steel products and that the S-N curves applicable for these stainless steel components are shown in Figure I-9.2.2 of ASME Section III. The applicant further indicates that the number of cycles postulated for the 40-year plant life was 10^{12} cycles.

The applicant indicates that the ASME S-N curve for stainless steels covers up to 10^{11} cycles and therefore an extrapolation of the S-N curve is necessary to accommodate the fatigue life which exceeds 10^{11} cycles. The applicant performed linear extrapolation of the S-log(N) curve, and extended the curve to 10^{13} cycles to allow coverage through the period of extended operation. The LRA states that for the 40-year baseline period, the maximum alternating stresses for each of these components were below the applicable alternating stress endurance limits and would therefore not develop fatigue cracking.

Using the expanded S-N curve, the applicant obtained an endurance limit corresponding to 10^{13} cycles. The applicant assumed a 4% reduction in endurance limit per decade of alternating cycles for the life beyond 10^{11}, along with a 0.9 factor to account for reduction in Young's modulus (since the S-N curve was established based on the material tests performed at the room temperature whereas the plant is operating at higher temperatures). For PWR plants, 600 °F temperature is typical.

The applicant obtained a 13,700 psi endurance limit corresponding to 10^{13} cycles, which bounds the maximum alternating stress (8,260 psi) for any of the RV internal components with a margin of about 39%. The applicant concluded that FIV would not cause fatigue failure to the RV internal components during the period of extended operation, pursuant to 10 CFR 54.21(c)(1)(ii).

4.3.5.2 Staff Evaluation

The staff reviewed LRA Section 4.3.5 to verify, pursuant to 10 CFR 54.21(c)(1)(ii), that the analyses have been projected to the end of the period of extended operation.

The staff finds the applicant's approach of finding the "endurance limit" by extrapolating the ultra high cycle portion of the S-N curve acceptable as discussed below:

The staff noted that for austenitic alloys such as stainless steels, the "endurance limit" steadily reduces as the number of applied stress cycles increases. This is demonstrated in Figure I-9.2.2 of ASME Section III, Division 1 Appendices, which shows a linear relationship between the alternating stress, S_a, and the fatigue life, N (with N in logarithmic scale), starting from the 8th decade of the fatigue life. The staff noted there is a companion table, ASME Table I-9.2.2, of ASME Figure I-9.2.2, which provides the same S_a versus N data except in digital form. To facilitate its review, the staff reproduced a segment of ASME Table I-9.2.2, matching Curve B, which is applicable to the present evaluation.

The staff reviewed this part of the LRA, as described below:

N (cycles)	Sa (ksi)
108	17.0
109	16.8
1010	16.6
1011	16.5

The above data show that over three decades, from $N=10^8$ to $N=10^{11}$, the "endurance limit" drops only 0.5 ksi. The staff noted that this gives an average rate of reduction in endurance limit a value of 0.167 ksi per decade of cycles. Equivalently, the endurance limit reduction rate is approximately 1% per decade of cycles (0.167/16.5) based on the last point of curve B of ASME Figure I-9.2.2, which is equivalent to the last data pair in the above table. Note that the applicant used a 4% reduction per decade of cycles to make its endurance limit projection, which is conservative and acceptable.

The staff notes that the S-N curve shown in ASME Figure I-9.2.2 is established for room temperature, T=70 °F. Therefore, when applying the S-N curve to components operating at higher temperatures, an adjustment to the S-N curve must be made. This is known as elastic modulus correction, which shifts the fatigue curve down by some computable amount. The staff noted the elastic modulus for stainless steels at room temperature is $E=28.3 \times 10^6$ psi. At a typical PWR operating temperature of T=600 °F, $E=25.3 \times 10^6$ psi for the stainless steels. The staff found these material data from Table TM-1, ASME Section III Part D. The required elastic modulus reduction factor is readily calculated by dividing $E_{600}=25.3 \times 10^6$ psi by $E_{70}=28.3 \times 10^6$ psi, which gives 0.894. The applicant used 0.90 which is acceptable because it is conservative.

On the basis of its review described above, the staff finds that the endurance limit (corresponding to $N=10^{13}$ cycles) the applicant calculated, 13,700 psi, is conservative and acceptable because the applicant used a much larger cycle reduction rate of 4% per decade versus 1% per decade which the staff estimated, to calculate the endurance limit. The staff notes that the maximum alternating stress of 8,260 psi in any of the RV internal components, is well below the endurance of 13,700 psi, by an ~ 39% margin.

4.3.5.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of reactor vessel internals flow-induced vibration analysis in LRA Section A.4.3.5. On the basis of the review of the UFSAR Supplement, the staff concludes that the summary description of the applicant's actions to address reactor vessel internals flow-induced vibration analysis is adequate.

4.3.5.4 Conclusion

On the basis of the review of the LRA, the staff concludes that the applicant has demonstrated pursuant to 10 CFR 54.21(c)(1)(ii) that the CLB analyses for RV internals flow-induced vibration analysis have been projected to the end of the period of extend operation. The staff also concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.3.6 Underclad Cracking Evaluation For Reactor Vessel

4.3.6.1 Summary of Technical Information in the Application

Underclad cracking has been detected in RV components that are fabricated from SA508, Class 2 forgings whose internal cladding was welding using a high heat submerged arc weld process. BAW-2274 (BAW-2251, Appendix C), contains an analysis of underclad cracking, which was performed as part of the Generic License Renewal Program for B&W plants using current ASME Code requirements and 48 EFPY fluence values. This analysis updates and supersedes the fracture mechanics analysis for underclad cracking as originally reported in BAW-10013. BAW-2274 evaluated three vessel regions: the nozzle belt, the closure head-to-head flange, and the beltline. The TMI-1 beltline plates are fabricated from SA 302, Grade B material, which is not susceptible to underclad cracking. Therefore, the beltline materials did not require analysis.

In BAW-2274, the controlling nozzle belt forging used in the evaluation was Oconee, Unit 3 forging 4680, with an adjusted RT_{NDT} at the 1/4T location of 159°F. The adjusted RT_{NDT} at the 1/4T location for TMI-1 nozzle belt forging ARY-59 at 52 EFPY was calculated to be 125.7°F, in comparison to 118°F reported in BAW-2274, Table 2-1 for 48 EFPY. The TMI-1 nozzle belt forging remains bounded by the BAW-2274 fracture mechanics analysis. BAW-2274, Table 2-2, indentified the limiting closure flange material based on an inside surface fluence of 7.78 x 10^{16} n/cm^2. For TMI-1, the fluence at 52 EFPY at the closure flange is 7.653 x 10^{14} n/cm^2, and therefore remains bounded by the BAW-2274 analysis. The analysis of underclad cracking reported in BAW-2274 remains valid for TMI-1 for 52 EFPY, based on a comparison of the fracture toughness properties evaluated in BAW-2274 with the 52 EFPY fluence projections for TMI-1. The fracture toughness margin for emergency and faulted conditions was 2.42, which is greater than the required toughness margin of 1.41.

In this section of the LRA, the applicant stated that since the updated analysis is based upon 40-year design transients, TMI-1 will continue to manage fatigue for these components using the 40-year design transient cycle limits in the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program.

4.3.6.2 Staff Evaluation

Topical Report BAW-2274 provides a fracture toughness and flaw growth analysis for underclad cracks that are postulated in the internal cladding of SA-508 Class 2 or 3 alloy steel components of B&W RVs. The staff accepted the fracture toughness and flaw growth analyses in BAW-2274 (BAW-2251, Appendix C) in a safety evaluation (SE) dated June 4, 1999 (ML0036702804). BAW-2274 included a PTS analysis. The staff concluded that neither the design basis transients nor the non-design basis transients will challenge the integrity of the vessel. The limiting RT_{PTS} values at the inner surface for ANO-1, Oconee-1, Oconee-2, and TMI-1 forgings at 48 EFPY were 90 °F, 136 °F, 113 °F, 175 °F, and 127 °F, respectively.

The staff independently calculated an RT_{PTS} of 133 °F for the TMI-1 nozzle belt forging ARY-59, using a fluence value at the wetted surface of 1.836 x 10^{19} n/cm^2 at 52 EFPY. This is higher than the RT_{PTS} value at 48 EFPY of 127 °F at the inner surface, from Table 2-1 of BAW-2274, but still significantly below the bounding inner surface RT_{PTS} value of 175 °F for the Oconee, Unit 3 nozzle belt forging. Therefore, the staff review determined that the updated adjusted reference temperature for the TMI-1 nozzle belt forging ARY-59 at 52 EFPY is less than the adjusted reference temperature of the limiting nozzle belt forging (Oconee, Unit 3 forging 4680) used in the BAW-2274 evaluation and does not affect the selection of the limiting nozzle belt material. Staff review determined that the fluence at 52 EFPY at the closure flange is less than the surface fluence analysis used in the BAW-2274 evaluation. Therefore, the TMI-1 nozzle belt forging and closure flange remain bounded by the BAW-2274 fracture mechanics analysis.

4.3.6.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of underclad cracking evaluation for reactor vessel in LRA Section A.4.3.6. On the basis of its review of the UFSAR Supplement, the staff has determined that the summary description of the applicant's actions to underclad cracking evaluation for reactor vessel is adequate.

4.3.6.4 Conclusion

On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(ii), that the applicant has projected the analysis for underclad cracking to the end of the period of extended operation. Since the updated analysis is based on 40-year old transient designs, pursuant to 10 CFR 54.21(c)(1)(iii), the applicant will adequately manage fatigue for these components using the 40-year design transient cycles as limits in the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program.

4.3.7 Reactor Coolant Pump Motor Flywheel Fatigue Crack Growth Analysis

4.3.7.1 Summary of Technical Information in the Application

LRA Section 4.3.7 discusses reactor coolant pump motor flywheel fatigue crack growth analysis. The analysis, which was performed by Westinghouse and documented in WCAP-14535A, includes a crack growth computation for a postulated radial flaw. The purpose of WCAP-14535A as stated within the document was to provide an engineering basis for elimination of flywheel inservice inspection requirements for all operating Westinghouse plants and for certain Babcock and Wilcox plants which specifically includes TMI-1. The WCAP-14535A Report included a critical crack size assessment based on a 1500 rpm of flywheel angular speed. WCAP-14535A provides the fatigue crack growth analyses results for an assumed radially oriented crack. The initial crack depth used in the analysis was 10% of the radial distance from the keyway to the outer rim of the flywheel. In the crack growth analysis, 6,000-cycles at a speed of 1,200 rpm was used. This is the transient condition and cycles postulated for 40 years of operation. The applicant concluded based on the WCAP results that the fatigue crack growth for the assumed flaw was negligible and no structural failure would occur when the flywheel speed is limited within 1500 rpm.

The applicant states in the LRA that the number of cycles applicable to the flywheel is the same as the number of RCP start-stop actions and these RCP actions are associated with plant heatups and cooldowns events. Thus, based on the design cycles for heatup and cooldown transients, the applicant indicates that there are 240 cycles applicable to the flywheel over 40 years. Projecting to 60 years, the applicant indicates there are 360 cycles for which the postulated crack in the flywheel would experience the most significant stress intensity factor. The applicant argued that the projected number of RCP starts and stops is not expected to exceed 6,000 cycles during the period of extended operation. The applicant disposes this flywheel TLAA to 10 CFR 54.21(c)(1)(ii).

4.3.7.2 Staff Evaluation

The staff reviewed LRA Section 4.3.7, pursuant to 10 CFR 54.21(c)(1)(ii), to verify that the analysis has been projected to the end of the period of extended operation.

RG 1.14, Revision 1, "Reactor Coolant Pump Flywheel Integrity" provides the staff's recommended acceptance criteria for material and minimum fracture toughness properties of SA 508, Classes 2 and 3, materials and SA 533 Grade B, Class 2, materials used in the fabrication of U.S. RCP flywheels. RG 1.14, Revision 1, also provides guidelines for performing structural integrity assessments of the RCP flywheels in U.S. light-water reactors, including assessments for ensuring the integrity of the flywheels against unacceptable fatigue-induced crack growth failures.

The applicant indicated that the fatigue crack growth assessments are based on the number of start-stop cycles assumed in the design specifications for the pumps. Therefore, to meet the 10 CFR 54.21(c)(1)(ii) acceptance criterion, the applicant indicated that it must demonstrate that the total number of RCP start-stop cycles, projected through the end of the extended periods of operation, will be bounded by the number of RCP start-stop cycles assumed in the fatigue crack growth analysis for the RCP flywheels.

The staff reviewed WCAP-14535A and confirmed that 6,000 start-stop cycles were assumed for the fatigue crack growth analysis. Based on this consideration, the staff finds the applicant's claim that the flywheel will maintain its structural integrity during the period of the extended operation acceptable because the number of start-stop cycles projected for 60 years is only 360, well below the 6,000 cycles limit used in the fatigue crack growth analysis.

4.3.7.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of the TLAA evaluation of the reactor coolant pump motor flywheel fatigue crack growth analysis in LRA Section A.4.3.7.

On the basis of the review of the UFSAR Supplement, the staff concludes that the summary description of the applicant's actions to address reactor coolant pump motor flywheel fatigue crack growth analysis is adequate.

4.3.7.4 Conclusion

On the basis of the review of the LRA, the staff concludes that the applicant has demonstrated pursuant to 10 CFR 54.21(c)(1)(ii) that the CLB analyses for the reactor coolant pump motor flywheel fatigue crack growth analysis has been projected to the end of the period of extended operation. The staff also concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.4 Leak-Before-Break Analysis of Primary System Piping

4.4.1 Summary of Technical Information in the Application

The Leak-Before-Break (LBB) analyses for the reactor coolant system (RCS) primary piping at Three Mile Island Unit 1 (TMI-1) are contained in Topical Report BAW-1999, "TMI-1 Nuclear Power Plant Leak-Before-Break Evaluation of Margins Against Full Break for RCS Primary Piping," April 1987 (BAW-1999), and Topical Report BAW-1847, Revision 1, "The B&W Owners Group Leak-Before-Break Evaluation of Margins Against Full Break for RCS Primary Piping of B&W Designed NSS," September 1985, (BAW-1847) that were reviewed and approved by the NRC staff for the current licensing period. The LBB analysis included fatigue flaw growth analyses, flaw stability analyses, and limit load analyses. In addition, the report qualitatively addressed thermal aging of reactor coolant pump (RCP) casings for the current period. The TLAAs for the LRA are:

(1) the fatigue flaw growth analysis
(2) the thermal aging evaluation of cast austenitic stainless steel (CASS) components

The fatigue flaw growth analyses are contained in BAW-1847, Revision 1 (and referenced in BAW-1999) and were prepared in accordance with guidance given in NUREG-1061, Volume 3. Specifically, a surface flaw was postulated at selected locations of the piping system (i.e. highest stress coincident with the lower bound of materials properties for base metal, welds, and safe ends). A fatigue crack growth analysis was performed to demonstrate that the surface flaw is likely to propagate in the through-wall direction and develop an identifiable leak before it will propagate circumferentially around the pipe to such an extent that it could cause a double-ended pipe rupture under faulted conditions. The fatigue flaw growth is based upon design transient inputs, including 240 heatup/cooldown cycles and 22 safe shutdown earthquake events, originally postulated to bound 40 years of operation. Since the number of cycles could potentially increase during the period of extended operation, the effects of aging will be managed during the period of extended operation using the Metal Fatigue of Reactor Coolant Boundary Program. The program will be used to monitor fatigue transient cycles and assure that the number of occurrences do not exceed design limits and assure that the fatigue flaw growth analysis remains valid during the period of extended operation.

Test data obtained by Argonne National Laboratory indicate that prolonged exposure of CASS to reactor coolant operating temperatures can lead to thermal aging embrittlement. The relevant aging effect is the reduction in the fracture toughness of the material as a function of time. The magnitude of the reduction depends upon the casting method (statically or centrifugally cast), material chemistry (e.g. delta ferrite and molybdenum content) and the duration of exposure at coolant operating temperature. An analysis was performed to evaluate thermal embrittlement of CASS suction and discharge nozzles for the RCP casings of the Babcock and Wilcox plants such as TMI-1. The LBB analysis was performed using material property assumptions that account for this reduction in fracture toughness properties. This analysis has been identified as a TLAA that requires evaluation for the period of extended operation.

An updated flaw stability analysis has been performed in support of a generic LBB analysis of the reactor coolant pump nozzles for ANO-1, Oconee-1, Oconee-2, Oconee-3, and TMI-1 to demonstrate that thermal embrittlement of the CASS nozzles will not prevent these components from performing their intended functions during the period of extended operation. Because this was a bounding analysis for the group of plants, the lower-bound properties of the most-susceptible material from any plant was evaluated, which was the SA-351, CF8M pump casing material applicable for ANO-1, Oconee-2, and Oconee-3. The pump casing material for TMI-1 is SA-351, CF8, which is less susceptible to thermal embrittlement. The generic analysis also assumed that each of these pump casings was fabricated from statically cast materials, which is conservative since the fracture toughness of statically-cast material is lower than that of centrifugally-cast materials.

The updated flaw stability analysis demonstrated that the CASS RCP casing materials and RCP piping meet all safety margin requirements of NRC's Standard Review Plan (SRP) 3.6.3, using the lower-bound CASS fracture toughness curves from NUREG/CR-6177, "Assessment of Thermal Embrittlement of Cast Stainless Steels," May, 1994. The most limiting material and location used in BAW-1847, Revision 1, were determined to be the base metal material of the straight section of the 28-inch cold leg pipe. Both the suction and discharge nozzles of the RCP casings are attached to the 28-inch cold leg pipes and have similar geometry and loading applied to them as the limiting location used for the LBB analysis.

4.4.2 Staff Evaluation

Pursuant to Title 10, of the *Code of Federal Regulations* (CFR), 10 CFR 54.21(c)(1)(i), the staff reviewed LRA Section 4.4 to verify that the applicant's TLAA for LBB for the RCS primary piping remain valid for the period of extended operation.

Pursuant to 10 CFR 54.21(c)(1)(iii), the staff verified that the effects of aging on the intended function of the RCS primary piping will be adequately managed for the period of extended operation. The TLAA of the LBB analyses are fatigue crack growth analyses of the subject piping and thermal aging of the CASS material of the RCS components because these two issues are time-dependent. In addition, the staff reviewed the impact of primary water stress corrosion cracking (PWSCC) and power uprate on the LBB piping.

4.4.2.1 Fatigue Crack Growth Analysis

LRA Section 4.4.1 states that the Metal Fatigue of Reactor Coolant Boundary Program will be used to monitor fatigue transient cycles to ensure that the number of transient occurrences do not exceed design limits. The staff determined that additional information was needed since it was not clear to the staff exactly how the Metal Fatigue of Reactor Coolant Boundary Program will be applied to monitor fatigue for the LBB piping. In RAI 4.4.1.0.-01, dated August 20, 2008, the staff requested that the applicant provide additional information discussing how often the

Metal Fatigue of Reactor Coolant Boundary Program monitors fatigue transient cycles, and discussing the definition of a significant thermal or pressure transient and providing the associated technical basis.

In its response to the RAI dated September 10, 2008, the applicant explained in detail that the AMP is applicable to all RCS piping and components to ensure that the number of actual plant transients do not exceed the number of transients used in the design fatigue analyses for these components. The LBB analyses are applicable only to the large-bore RCS piping and the RCPs. Therefore, these components are all within the scope of the program. The LBB analysis used the same number of design transients as the design fatigue analyses since they were derived from the same functional specifications. Therefore, the monitoring program will also ensure that the number of transient cycles experienced by the plant will be within the cycles used in the LBB analysis during the period of extended operation.

The applicant stated that when a plant transient occurs, control room operators are required to document the event in the transient cycle log if the transient meets any of the transient definitions provided in the TMI-1 fatigue monitoring procedure. They also record thermal, pressure, flow, level and/or actuation data as required for the particular transient that occurred to validate the transient type. The fatigue monitoring program engineer is required to review the transient logbook semi-annually, validate that each actual transient is bounded by the applicable design transient definition, update the cycle counts, compare actual numbers of cycles to limits, and prepare a transient summary report. The applicant will perform a corrective action when a transient is approaching 80% of its limit.

The applicant stated that transients are deemed "significant" if they affect stress cycles significantly due to the rate of change of RCS temperature and pressure during the event. Transients can be divided into two main categories: trip and non-trip. The primary difference in these two categories with regard to stress cycles is the rate of change of RCS temperatures and pressures. The reactor trips exhibit much faster changes in RCS temperature than the non-trip transients (approximately ten times faster), and are therefore monitored. Non-trip transients are also considered significant if they result in a high rate of change of core average temperature. Examples include heatups and cooldowns (450-degree change at a rate between 0.5 and 1.5 degrees per minute), Integrated Control System runbacks (up to 10-degrees per minute), and 10% step changes. For monitoring purposes, "non-significant" transients have a negligible impact on stress cycles.

Based on its review, the staff finds the applicant's response to RAI 4.4.1.0-01 acceptable because the applicant provided adequate information concerning how often the Metal Fatigue of Reactor Coolant Boundary Program monitors fatigue transient cycles, and provided the definition of a significant thermal or pressure transient and provided the associated technical basis. The staff finds the frequency and definitions provided by the applicant acceptable. The staff's concern described in RAI 4.4.1.0-01 is resolved.

The staff finds that the applicant has appropriate procedures to monitor transients under the program to ensure that the number of transients accumulated throughout the life of the plant including the period of extended operation is within the number of transients used in the LBB analysis.

As part of its review of the TLAA of the LBB piping, the staff questioned the scope and history of LBB piping inspection and determined that additional information was needed. In RAI 4.4.1.0-04, dated August 20, 2008, the staff requested that the applicant provide additional information and discuss the inspection history of the piping systems that have been approved for LBB, *including inspection results and frequency.*

In its response to the RAI dated September 10, 2008, the applicant stated that the TMI-1 LBB analyses include the 36-inch hot leg piping that connects the reactor vessel to the steam generators, the 28-inch cold leg piping that connects the steam generators to the reactor coolant pumps, and the 28-inch cold leg piping that connects the reactor coolant pumps to the reactor vessel. These components are subject to periodic examination by the ASME Section XI inservice inspection (ISI) program.

The applicant stated that the 36-inch diameter carbon steel hot leg piping includes a total of 36 Category B-J (pressure-retaining) welds (24 circumferential and 12 longitudinal). The 28-inch diameter carbon steel cold leg piping includes a total of 119 Category B-J welds (71 circumferential and 48 longitudinal) and 8 Category B-F welds (Alloy 600 welds that connect the carbon steel cold leg piping to the forged stainless steel safe ends attached to the RCP nozzles).

The applicant stated that from original plant startup in 1974 through the 2003 refueling outage, the traditional ASME B&PV Code Section XI ISI program was used. This includes all three periods of the first and second ten-year inspection intervals and the first period of the third ten-year inspection interval. The TMI-1 Inservice Inspection (ISI) Program required 100 % of the 8 Category B-F welds to be surface-examined and volumetrically examined during each ten-year inspection interval. Each of these welds was examined during each of the first two ten year inspection intervals with satisfactory results. The ISI program also required 25 % of the combined total of Category B-J and Category B-F circumferential welds to be examined in accordance with ASME Section XI or alternatives approved by the NRC during each ten-year inspection interval. The required sample of these welds was examined during the first two ten year inspection intervals with acceptable results. During the first period of the third ten-year inspection interval, additional examinations were performed for six circumferential Category B-J welds, one longitudinal Category B-J weld, and one Category B-F (Alloy 600) weld within the LBB piping. Each examination had acceptable results.

The applicant stated that beginning with the second period of the third inspection interval, the TMI-1 ISI program was changed to a risk-informed program. The NRC approved the TMI-1 Risk-Informed Inservice Inspection (RISI) Program under relief request RR-00-21 in November 2003. It was implemented for examinations in the second period of the third ten-year inspection interval, which began with the 2005 refueling outage. The RISI program characterizes the previous Category B-J and Category B-F welds as Category R-A, Medium Risk Category 4 welds. The RISI program requires examination of 10 % of the total population of the RCS Medium Risk Category 4 welds during each ten-year inspection interval. No examinations have been completed for these LBB welds under the RISI program to-date.

The applicant stated that the eight Category B-F (Alloy 600) welds are subject to minimum examination requirements from the industry guidance, MRP-139, "EPRI Materials Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guidelines (MRP-139)." The initial MRP-139 volumetric examinations are required to be completed no later than December 31, 2010. Subsequent volumetric and bare metal visual examinations are performed as specified in Tables 6-1 and 6-2 of MRP-139. Table 6-1 of MRP-139, PWSCC Category E, is appropriate for these Alloy 82/182 welds and it specifies the volumetric inspection requirement as once every 6 years. Table 6-2 of MRP-139, PWSCC Category K, specifies the frequency for visual inspections as once every three refueling outages. The TMI-1 ISI program specifies examinations of these Alloy 600 welds in accordance with these MRP-139 requirements.

Based on its review, the staff finds the applicant's response to RAI 4.4.1.0-04 acceptable because the applicant provided a discussion of the inspection history of the piping systems that have been approved for LBB, and also included the inspection results and frequency. The staff's concern described in RAI 4.4.1.0-04 is resolved.

The staff finds that the applicant has inspected the LBB piping consistently in accordance with the ASME B&PV Code, Section XI, and MRP-139. Therefore, the applicant's inspection of LBB piping and RCP is acceptable.

4.4.2.2 Thermal Embrittlement of Cast Austenitic Stainless Steel

The staff noted that the current ultrasonic testing (UT) technique has not been qualified through performance demonstration to examine CASS material in accordance with the ASME Code, Section XI. The staff determined that additional information was needed to complete its review. In RAI 4.4.2.0-02, dated August 20, 2008, the staff requested that the applicant provide additional information discussing how the RCP casing can be examined to determine its structural integrity, discussing the inspection history of the RCP casing, and discussing the inspection of the welds if the welds between the RCP nozzles and the pipe are fabricated with Alloy 82/182 filler metal.

In its response to the RAI dated September 10, 2008 the applicant stated that LRA Table 3.1.2-1 provides the Aging Management Review Results (AMRR) for the RCS, including the results for the RCP casing. One of the line items identifies loss of fracture toughness due to thermal aging embrittlement as an aging effect requiring management, and identifies the AMP as the ASME Section XI, Inservice inspection, Subsections IWB, IWC, and IWD Program. The applicant stated that the TMI-1 Inservice Inspection (ISI) Program Plan, Third Ten-Year Inspection Interval, invokes the inspection requirements from the 1995 Edition, 1996 Addenda of ASME Section XI for ASME Class 1 components. Table IWB-2500-1 of ASME Section XI categorizes pump casings as Examination Category B-L-2. Visual, VT-3 examination of the internal surface is required only when a pump is disassembled for maintenance, repair, or volumetric examination. In accordance with these requirements, Inservice Inspection Summary Table 7.1-1 of the ISI Program Plan also specifies Visual VT-3 examination of Category B-L-2 Pump Casings. The TMI-1 RCP casings do not contain Category B-L-1 welds. Therefore, no volumetric examination of the pump casings is required by ASME Section XI or by the ISI Program Plan.

The applicant stated that the TMI-1 RCS has a total of four RCPs; RC-P-1A, RC-P-1B, RC-P-1C, and RC-P-1D. Pump RC-P-1B was visually examined during the 1981 to 1984 outage in accordance with ASME Section XI requirements due to a maintenance disassembly and the results were satisfactory. Pump RC-P-1C was visually examined during the 1999 refueling outage due to a maintenance disassembly and the results were satisfactory.

The applicant stated that a forged stainless steel safe end separates each CASS RCP nozzle from the carbon steel RCS piping. A stainless steel weld joins each CASS RCP nozzle to the forged stainless steel safe end pipe. Therefore, there are no Alloy 82/182 welds joining the CASS pump casing nozzles to the pipe. The applicant noted that the RCP casings are the only CASS components within the TMI-1 RCS primary piping, and therefore the only CASS components within the scope of the LBB analysis.

Based on its review, the staff finds the applicant's response to RAI 4.4.2.0-02 acceptable because the applicant provided the additional information requested in the RAI and provided adequate discussions of how RCP casings are examined to determine their structural integrity, the inspection history of the RCP casings, and that there are no alloy 82/182 welds joining the pump casing nozzles to the pipe. The staff's concern described in RAI 4.4.2.0-02 is resolved.

By letter dated May 19, 2000, Christopher I. Grimes of the NRC forwarded to Douglas J. Walters of Nuclear Energy Institute an evaluation of thermal aging embrittlement of CASS components (ADAMS Accession ML003717179). In the NRC's May 19, 2000 letter, the staff provided its positions on how to manage CASS components. The staff determined that additional information was needed to complete its review. In RAI 4.4.1.0-03, the staff requested that the applicant provide additional information discussing how the CASS casing of the RCP satisfies the staff positions in the May 19, 2000 letter.

In its response to the RAI dated September 10, 2008, the applicant stated that the RCP casing satisfies the staff positions in the May 19, 2000 letter. The NRC evaluation in the May 19, 2000 letter states: "Valve bodies and pump casings are adequately covered by existing inspection requirements in Section XI of the ASME Code, including the alternative requirements of ASME Code Case N-481 for pump casings. Screening for susceptibility to thermal aging is not required and the current ASME Code inspection requirements are sufficient." In addition, Table 3 of the NRC evaluation specifies ASME Section XI examination requirements for CASS Pump Casings (Base Metal).

Based on its review, the staff finds the applicant's response to RAI 4.4.2.0-03 acceptable because the applicant has inspected the RCP casing consistently with the staff positions as discussed in the NRC's letter dated May 19, 2000, and, the ASME Code, Section XI. The staff's concern described in RAI 4.4.2.0-03 is resolved.

LRA Section 4.4.2 states that the lower-bound CASS material properties (e.g., fracture toughness) were used to show acceptability of CASS material for the period of extended operation. The staff determined that additional information was needed to complete its review. In RAI 4.4.2.0-05, dated August 20, 2008, the staff requested that the applicant provide additional information clarifying whether the lower-bound CASS material properties are bounding for the CASS material properties at the end of 60 years.

In its response to the RAI dated September 10, 2008, the applicant stated that the lower-bound Charpy-impact energy and fracture toughness properties for the CASS pump casings described in Section 4.4.2 of the LRA will not reduce further over time, and are therefore bounding for the CASS material properties at the end of 60 years. This is because the material property values were developed from lower-bound fracture toughness curves prepared by Framatome Technologies in accordance with NUREG/CR-6177, "Assessment of Thermal Embrittlement of Cast Stainless Steels," May 1994. NUREG/CR-6177 provides two methods for predicting Charpy-impact energy and fracture toughness values of CASS, as described below.

The applicant stated that the first method estimates the extent of thermal embrittlement at saturation, i.e., the minimum impact energy that can be achieved for the material after long-term aging, and is determined based upon actual values for the chemical composition of the steel.

The second method, which is the lower-bound method, provides an even more conservative estimate of the fracture toughness values when specific chemical composition of the CASS material is unknown. A predicted lower-bound J-R curve is developed for CASS of unknown chemical composition for a given grade of steel, ferrite content, and temperature. The lower-bound curve is based upon the worst-case material condition and also produces values that will not reduce further over time. Framatome elected to use this second method in determining the fracture toughness values described in LRA Section 4.4.2 because it is simpler and provides satisfactory results. Therefore, the analysis described in Section 4.4.2 developed predicted lower-bound fracture toughness values that are bounding for the CASS material properties at the end of 60 years.

Based on its review, the staff finds the applicant's response to RAI 4.4.2.0-05 acceptable because the applicant stated that the lower-bound Charpy-impact energy and fracture toughness properties for the CASS pump casings will not reduce further over time, and are bounding for the CASS material properties at the end of 60 years. The staff's concern described in RAI 4.4.2.0-05 is resolved.

In Section 4.4.2 of the LRA, the applicant discusses several flaw stability analyses in support of a generic LBB analysis. The staff determined that additional information was needed to complete its review. In RAI 4.4.2.0-01, dated August 20, 2008 the staff requested that the applicant provide additional information regarding the flaw stability analysis.

In its response to the RAI dated September 10, 2008, the applicant stated that there is only one flaw stability analysis as discussed in LRA Section 4.4.2. The original flaw stability analysis applicable to TMI-1 is described in BAW-1999, "TMI-1 Nuclear Power Plant Leak-Before-Break Evaluation of Margins Against Full Break for RCS Primary Piping," April 1987. This analysis was performed in accordance with the criteria specified in NUREG-1061, Volume 3. The updated flaw stability analysis was issued in 1998 to address thermal aging of the CASS RCP casings for the period of extended operation in accordance with the criteria specified in the Standard Review Plan 3.6.3. This updated flaw stability analysis is described in Framatome Technologies Report 51-5000709-00, "Assessment of TLAA Issues in LBB Analysis of RCS Primary Piping," dated January 30, 1998. Report 51-5000709-00 is submitted as an Attachment to the September 10, 2008 letter.

The staff finds that Framatome used a conservative method to obtain the conservative fracture toughness for the CASS. The staff finds that the RCP nozzles, with consideration of thermal aging and the additional period of extended operation, meets all the safety margin criteria of SRP 3.6.3. The staff finds that thermal embrittlement of LBB piping components that are made of CASS has been considered in the design and piping components have been found to be acceptable.

Based on its review, the staff finds the applicant's response to RAI 4.4.2.0-01 acceptable because the applicant provided the needed clarification of the flaw stability analysis so the staff could complete its review. The staff's concern described in RAI 4.4.2.0-01 is resolved.

4.4.2.3 Impact of PWSCC on LBB Piping

Recent industry experience has shown that Alloy 82/182 dissimilar metal butt welds are susceptible to PWSCC in pressurized water reactors. The industry took actions to address PWSCC in butt welds when it issued MRP-139. MRP-139 provides scheduler guidance to licensees for completing initial and subsequent inspections of primary system piping butt welds originally fabricated with Alloy 82/182. The NRC staff concluded that the industry's MRP-139 inspections provided an adequate approach for ensuring integrity until ASME Code requirements for inspection of dissimilar metal butt welds are revised to provide a regulatory framework for ensuring that ASME Code-allowable limits would not be exceeded, leakage would not occur, and potential PWSCC flaws would be detected before they challenged the structural or leakage integrity of piping welds.

Code Case N-770, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material With or Without the Application of Listed Mitigation Activities, Section XI, Division 1," was approved by ASME on January 30, 2009, and is being published in Supplement 8 of the 2007 Edition of the ASME Boiler and Pressure Vessel Code Nuclear Code Cases book. This code case was specifically written to provide inspection requirements to address potential PWSCC in Alloy 82/182 butt welds. The NRC is considering incorporating by reference the requirements of Code Case N-770 into 10 CFR 50.55a. Should the incorporation by reference occur, the inspection requirements of Code Case N-770 will supersede the inspections performed under MRP-139.

In RAI 4.4.1.0-02, dated August 20, 2008, the staff requested that the applicant provide additional information regarding (a) the actions that will be taken to mitigate and/or inspect the Alloy 82/182 welds in the LBB piping to ensure that PWSCC will not affect the structural integrity of the LBB piping, and (b) the validity of the original LBB analyses in light of industry experience in PWSCC of Alloy 82/182 butt welds.

In its response to RAI 4.4.1.0-02 dated September 10, 2008, the applicant stated that within the scope of the LBB analysis, there are a total of eight Alloy 82/182 dissimilar metal butt welds that are associated with the suction and discharge nozzles of the four RCPs. A forged stainless steel safe end is installed in each line between the CASS RCP nozzle and the carbon steel pipe. The Alloy 82/182 welds join the forged stainless steel safe end to the carbon steel RCS piping.

Currently, the Alloy 82/182 dissimilar metal welds are scheduled for examination every third refueling outage per the guidance of MRP-139. The initial MRP-139 examinations are required to be completed no later than December 31, 2010. This includes UT and bare metal visual inspection. Any future mitigation actions would be performed in accordance with the requirements of 10 CFR 50.55a and ASME Section XI. The accelerated inspection schedule of MRP-139 will continue to be followed until ASME Code Case N-770 is incorporated by reference in the regulations.

In pressurized water reactors, inspections qualified in accordance with the requirements of the ASME Code, Section XI, have found a number of indications attributed to PWSCC. However, most of these indications have been found in pressurizer piping which operates at a higher temperature than the temperature of the LBB piping at TMI. Because of its higher temperature, pressurizer piping is more susceptible to PWSCC than the LBB piping at TMI. In addition, none of the indications of PWSCC were evaluated to be structurally significant at the time of their discovery.

The staff finds that the applicant has satisfactorily addressed the impact of PWSCC on Alloy 82/182 welds in LBB piping based on operating experience and on the inspections the licensee is taking to manage the potential for PWSCC in Alloy 82/182 butt welds. In addition, if Code Case N-770 is incorporated by reference into 10 CFR 50.55a, the applicant will be required to perform the examinations specified in Code Case N-770 as conditioned in the regulations. The staff is working on a long-term generic revision of the regulatory framework for managing PWSCC. This revised framework will be based upon probabilistic fracture mechanics analyses. As a result of the ongoing study, should the NRC issue additional requirements in the future for managing degradation in LBB piping, the applicant will be required to satisfy those requirements.

4.4.2.4 Impact of Power Uprate on LBB Piping

The NRC approved a 1.3% stretch power uprate for TMI-1 on July 28, 1988 (ADAMS Accession number ML003765237). The staff determined that additional information was needed to complete its review. In RAI 4.4.1.0-03, dated August 20, 2008 the staff requested that the applicant provide additional information regarding the impact of the operating conditions of power uprates on the LBB piping at the end of 60-years.

In its response to the RAI dated September 10, 2008, the applicant stated that the LBB analyses were developed using the reactor coolant system design operating temperatures and pressures that are based upon 2568 MWt (megawatt thermal), which is both the design power level and licensed power level after the 1.3 % power uprate. Therefore, there is no impact from the 1.3% stretch power uprate on the LBB analyses.

The applicant stated that even though TMI-1 was designed for 2568 MWt, TMI-1 was initially licensed to 2335 MWt on the basis of the original design parameters for the main turbine-generator. Subsequent modifications were made to the turbine blading that resulted in significant improvements in turbine efficiency and therefore plant electrical output. As a result, the applicant requested a license amendment to increase the licensed power level to the design power level of 2568 MWt.

As discussed in the staff's safety evaluation approving the power uprate, the staff evaluated the fuel system design, the nuclear design, thermal hydraulic design, accident and transient analysis and Technical Specification changes. The staff concluded that the proposed power uprate does not change the original design conditions and that all existing reactor design and safety criteria are preserved at the higher power level of 2568 MWt. With this 1.3% stretch power uprate from 2335 MWt to 2568 MWt, TMI-1 is operating at the original design conditions. Based on the above information, the staff finds that the power uprate does not affect the LBB piping because the temperature and pressure conditions after the power uprate are the same as at the design power level.

Based on its review, the staff finds the applicant's response to RAI 4.4.1.0-03 acceptable because the applicant provided an adequate discussion of the operating conditions of the power uprate on the LBB piping at the end of 60 years. The staff's concern described in RAI 4.4.1.0-03 is resolved.

4.4.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA of the LBB analyses of primary system piping in LRA Section A.4.4. LRA Section A.4.4.1 provided the UFSAR Supplement summary description for the fatigue flaw growth analysis, and LRA Section A.4.4.2 provided the UFSAR Supplement for thermal aging embrittlement of cast austenitic stainless steel reactor coolant pump casings. On the basis of its review of the UFSAR Supplement, the staff concludes that the summary descriptions of the applicant's actions to address the TLAA for the primary system piping LBB analyses including fatigue flaw growth analysis and thermal aging embrittlement of cast austenitic stainless steel reactor coolant pump casings is adequate.

4.4.4 Conclusion

On the basis of its review of the TLAA in LRA Section 4.4, the staff concludes that pursuant to 10 CFR 54.21(c)(1)(i), the applicant has demonstrated that the LBB analyses for the RCS primary piping remain valid for the period of extended operation. Pursuant to 10 CFR 54.21(c)(1)(iii), the applicant has demonstrated that the effects of aging on the intended function of the RCS primary piping will be adequately managed for the period of extended operation. The staff also concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.5 Fuel Transfer Tube Bellows Design Cycles

4.5.1 Summary of Technical Information in the Application

LRA Section 4.5 describes the fuel transfer tube bellows and design cycles. The applicant stated that the fuel transfer tube connects the fuel transfer canal inside the primary building to the spent fuel pool located inside the fuel handling building. The fuel transfer tube passes through the primary containment wall and through the exterior wall of the fuel handling building. There are three flexible bellows in the fuel transfer system connecting the containment building to the spent fuel pool in the fuel handling building.

The fuel handling building penetration consists of a penetration sleeve through the wall, and two flexible bellows outside and inside the wall that connect the penetration sleeve to the transfer tube. The fuel transfer tube and the fuel transfer canal in the containment building are connected by a flexible bellows that performs the leakage boundary function of preventing refueling water of leaking inside containment. This bellows is not part of the primary containment pressure boundary. This function is performed by the penetration sleeve, the closure plate and the fuel transfer tube.

The bellows were designed to the ASME Code, Section VIII. Each of the three bellows was designed for a minimum of 5,000-cycles of expansion and contraction cycles for 40 years of operation. These design analyses are therefore TLAAs in accordance with 10 CFR 54.3, requiring evaluation for the period of extended operation.

To determine if the design analyses remain valid to the end of the period of extended operation, the applicant projected the number of cycles for 60 years of operation. Each refueling operation consists of one thermal cycle, which begins when the transfer canal is filled with water for refueling and ends when the canal is drained at the end of the refueling operation. Forty such refueling operations are estimated to occur in 60 years of operation, based on an 18 month interval between refueling operations. The applicant stated that this is conservative since refueling operations are now conducted every 24 months. In addition to these thermal cycles, the fuel transfer canal penetration assembly also experiences pressurization cycles during Integrated Leak Rate Tests, projected to occur once every five years, compared to a maximum interval of once every ten years. In addition, these penetrations are also assumed to be exposed to postulated 20 Safe Shutdown Earthquake cycles. The total number of cycles projected for 60 years is therefore 72 cycles.

4.5.2 Staff Evaluation

LRA Section 4.5 states that the fuel transfer tube bellows were designed for a life of 5,000-cycles. The applicant also estimated the number of cycles that the bellows will experience, projected to the end of the period of extended operation, as 72. The ASME Section VIII fatigue design criterion for bellows requires that the number of operating cycles be less than the number of design cycles. The number of 72 cycles over the life of the plant as compared to 5000 design allowable cycles meets this criterion, and is therefore acceptable. Therefore, the fuel transfer tube bellows fatigue TLAAs remain valid for the period of extended operation and have been dispositioned in accordance with 10 CFR 54.21(c)(1)(i).

4.5.3 UFSAR Supplement

The applicant provided an UFSAR Supplement summary description of its TLAA evaluation of the fuel transfer tube bellows design cycles in LRA Section A.4.5. On the basis of its review of the UFSAR Supplement, the staff concludes that the summary description of the applicant's actions to address the fuel transfer tube bellows design cycles is adequate.

4.5.4 Conclusion

The staff has reviewed the licensee's submittal, in accordance with the GALL Report and finds that the number of cycles to which the fuel transfer bellows are designed will not be exceeded for the life of the plant. On the basis of its review, the staff concludes that the applicant has demonstrated that, pursuant to 10 CFR 54.21(c)(1)(i), the analyses of the Unit 1 fuel transfer bellows TLAA remains valid for the period of extended operation. The staff also concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.6 Crane Load Cycle Limits

LRA Section 4.6 states that load cycle limits for cranes was identified as a potential TLAA and that the following two types of cranes are included in the scope of license renewal and have been identified as TLAA items, which require evaluation for 60 years to assure adequate structural integrity during the period of the extended operation:

(a) Reactor Building Crane (185-ton capacity)
(b) Fuel Handling Building Crane (110-ton capacity)

Since the TLAA analyses for both of these cranes are essentially identical, the staff has combined its comments and evaluations for both cranes in the following sections.

4.6.1 Summary of Technical Information in the Application

LRA Section 4.6 states that both the reactor building crane and the fuel handling building crane were designed based on the same Code, EOCI-61, "Specifications for Electric Overhead Traveling Cranes-1961," which was the design specifications for the period prior to the issuance of the Crane Manufacturers Association of America (CMAA) Specification 70. The applicant also stated that both of these cranes are compliant with the cyclic loading requirements of CMAA-70, Class A1 which states that the cranes are capable of enduring at least 20,000 lifting cycles.

The applicant further stated that the total number of lift cycles for any of the crane members will be less than 2,000-cycles over the original 40-year plant design life, as shown in a TMI-1 response (dated February 21, 1984) to NUREG-0612, "Control of Heavy Loads in Nuclear Power Plants." The applicant concluded that both the reactor building crane and the fuel handling building crane will be safe for use during the period of extended operation.

4.6.2 Staff Evaluation

The staff reviewed LRA Section 4.6, pursuant to 10 CFR 54.21(c)(1)(ii), to verify that the analysis remains valid for the period of extended operation.

Fundamentally, the design Code, ECOI-61, which is consistent with CMAA-70 Class A1, has built in implicit fatigue analysis requiring the cranes to endure at least 20,000 lifting cycles. The projected 3,000 lifting cycles over a 60-year period is clearly well within the original design requirements. The staff finds that the applicant's claim that the structural integrity of the reactor building crane and the fuel handling building crane will be maintained during the period of the extended operation acceptable because the projected lifting cycles are well below the crane design limit of 20,000-cycles.

During the audit, the staff asked the applicant even though there are numerous cranes and hoists listed in LRA Section 2.3.3.7, why only the reactor building crane and the fuel handling building crane were evaluated for load cycle limits. The applicant indicated that it was because other than the reactor building crane and the fuel handling building crane which were identified as TLAAs, the other cranes and hoists are being managed under the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program.

Projecting to 60 years of service, the staff finds that neither of the cranes will exceed 3,000 lifting cycles, a number well below the lower bound of the crane design life of 20,000-cycles. The staff finds the applicant's handling of cranes and hoists aging management acceptable because it is consistent with the GALL Report Section XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems."

4.6.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of crane load cycle limits in LRA Section A.4.6. LRA Section A.4.6.1 provides the UFSAR Supplement summary description for the reactor building crane and LRA Section A.4.6.2 provides the UFSAR Supplement summary description for the fuel handling building crane. On the basis of the review of the UFSAR Supplement, the staff concludes that the summary description of the applicant's actions to address crane load cycle limits is adequate.

4.6.4 Conclusion

On the basis of its review, the staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1)(ii), that the load cycle limits for cranes have been projected to the end of the period of extended operation. Additionally, the staff concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.7 <u>Loss of Prestress in Concrete Containment Tendons</u>

4.7.1 Summary of Technical Information in the Application

LRA Section 4.7 summarizes the evaluation of the concrete containment tendon prestress analysis for the period of extended operation. The applicant stated that the TMI-1 reactor building (containment) is a reinforced and post-tensioned concrete structure composed of a cylindrical wall with a flat foundation mat and a shallow dome roof. It is designed to American Concrete Institute (ACI) 318-63. The time dependent losses were calculated for 40 years and documented in vendor manual VM-TM-2485, as referenced in UFSAR Section 5.7.5.2.3b, which is a TLAA. The applicant also stated that the post-tensioning system consists of three groups of tendons: (1) 166 vertical tendons anchored at the top of the ring girder and the bottom of the base mat; (2) 330 hoop tendons anchored at six vertical buttresses equally spaced around the cylinder wall; and (3) 147 dome tendons that anchor at the vertical face of the ring girder. The tendons consist of 169 wires of ¼ inch diameter with a specified minimum ultimate tensile strength of 240 ksi and they are enclosed in galvanized steel conduits filled with a corrosion protection medium (grease). Tendons were initially tensioned to a force of approximately 1,400 kip.

For the TLAA, the applicant noted that the original design included a calculation of expected loss of prestress for the plant design life in accordance with ACI 318-63. The calculation evaluated loss of prestress due to elastic shortening during initial stress operations as well as time dependent losses resulting from tendon relaxation, concrete shrinkage, and concrete creep. Furthermore, the applicant noted that the TMI-1 tendon prestressing forces decrease much more rapidly in the first few years following tensioning and relatively slowly from about the 10th year on.

The TLAA AMP "Containment Program Tendon Prestress" program as described in the LRA is developed under 10 CFR 54.21(c)(1)(iii), which is part of the TMI-1 ASME Section XI, Subsection IWL Program. The TLAA AMP is based on the 1992 Edition, with 1992 Addenda, of the ASME Boiler and Pressure Vessel Code, Section XI and includes confirmatory actions that monitor loss of containment tendon prestressing forces during the current term and will continue through the period of extended operation. Assessments of the results of the tendon prestressing force measurements are performed in accordance with ASME Section XI, Subsection IWL to confirm adequacy of the prestressing forces. The applicant stated that the measured forces meet acceptance criteria specified in ASME Section XI, Sub-Section IWL, which includes (1) the force in each sample tendon is at least 95% of the force predicted for that tendon at the time of the measurement; and (2) vertical, hoop and dome sample mean forces are above the minimum required value (MRV), and regression analyses incorporating current and prior surveillance measurements show that trended vertical, hoop and dome group mean forces will not fall below the MRV prior to the deadline for completion of the subsequent surveillance.

4.7.2 Staff Evaluation

The staff reviewed LRA Section 4.7, pursuant to 10 CFR 54.21(c)(1)(iii), to verify that the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Pursuant to 10 CFR 54.21(c)(1)(iii), GALL AMP X.S1 "Concrete Containment Tendon Prestress" "monitoring and trending" program element suggests that the estimated and measured prestressing forces are plotted against time and the predicted lower limit (PLL), MRV, and

trending lines developed for the period of extended operation. The staff noted that the applicant takes exception to the "acceptance criteria" element of GALL X.S1. Instead of using PLL as recommended in Regulatory Guide 1.35, TMI-1 revised its program to comply with ASME Section XI, Subsection IWL. IWL requires measured individual tendon force to be at least 95% of the predicted forces. The applicant uses the actual design basis forces as predicted forces. The staff noted that 95% of the PLL specified in Regulatory Guide 1.35.1 is less than 95% of the actual design basis forces. Therefore, the staff finds the program exception acceptable because theTMI-1 acceptance criteria are more conservative than the GALL acceptance criteria.
The staff's evaluation of the applicant's Concrete Containment Tendon Prestress program is documented in SER Section 3.0.3.1.26. In its review, the staff noted that the plots or data for the historically inspected tendon forces, predicted forces, trend lines, and minimum required values (MRV) were not presented in the applicant's LRA. In RAI 4.7-1, dated September 30, 2008, the staff requested that the applicant provide additional information regarding the log-year graphs of individual tendon forces versus 95% of the predicted force, and also provide trend lines against MRV to confirm the adequacy of the prestressing forces.

In its response to the RAI dated October 23, 2008, the applicant provided six graphs to demonstrate the adequacy of the prestressing forces of TMI-1 concrete containment tendons. The first three graphs illustrate the individual measured tendon forces and MRV for each tendon group for vertical, hoop and dome. These graphs also indicate the measured tendon force trend lines and 95% lower confidence limit (LCL) projected through the period of extended operation. The other three graphs illustrate the measured control tendon forces and MRV for each control tendon. Also indicated are the measured control tendon force trend lines and predicted force trend lines for each control tendon projected through the period of extended operation.
In the same response, the applicant further stated that the third paragraph in the "Analysis" portion of LRA Section 4.7 should have included the acceptance criteria per ASME Section XI, Subsection IWL, paragraphs IWL-3221.1(b)(1), (2) and (3). As a result, the applicant revised the paragraph to reflect this inclusion.

Based on its review, the staff finds the applicant's response to RAI 4.7-1 acceptable because the Acceptance Standards per ASME Section XI, Subsection IWL, Article IWL-3000 are followed. The graphs provided by the applicant have confirmed the adequacy of the prestressing forces. Therefore, the staff's concern described in RAI 4.7-1 is resolved.
The staff reviewed LRA Section 4.7, and the relevant references cited in the TLAA, and finds that the applicant has adequate procedures in place for monitoring and trending the containment prestressing forces. The staff also finds that the applicant's choice to manage this TLAA pursuant to 10 CFR 54.21(c)(1)(iii) is acceptable. The staff, therefore, concludes that in conjunction with the Containment Program Tendon Prestress Program, the prestressing tendon forces in containment will be adequately managed.

4.7.3 UFSAR Supplement

The applicant provided an UFSAR Supplement summary description of its TLAA evaluation of the concrete containment tendon prestress analysis in LRA Section A.4.7. On the basis of its review of the UFSAR Supplement, the staff concludes that the summary description of the applicant's actions to address the concrete containment tendon prestress analysis is adequate.

4.7.4 Conclusion

On the basis of its review, the staff concludes that the applicant has demonstrated, pursuant to 10 CFR 54.21(c)(1)(iii), that, for the concrete containment tendon prestress analysis, the effects of aging on the intended function(s) will be adequately managed for the period of extended operation in conjunction with the AMP which was developed by the applicant for this TLAA under 10 CFR 54.21(c)(1)(iii) in order to ensure the adequacy of prestressing forces in prestressed concrete containment tendons during the period of extended operation. The staff also concludes that the UFSAR Supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.8 Environmental Qualification of Electrical Equipment

The 10 CFR 50.49 EQ program is a TLAA for purposes of license renewal. The TLAA of the environmental qualification (EQ) of electrical components includes all long-lived, passive, and active electrical and I&C components that are important to safety and are located in a harsh environment. The harsh environments of the plant are those areas subject to environmental effects by loss-of-coolant accidents or high-energy line breaks. EQ equipment comprises safety-related and Q-list equipment, nonsafety-related equipment the failure of which could prevent satisfactory accomplishment of any safety-related function, and necessary post-accident monitoring equipment.

As required by 10 CFR 54.21(c)(1), the applicant must provide a list of EQ TLAAs. The applicant shall demonstrate that for each type of EQ equipment, one of the following is true: (1) the analyses remain valid for the period of extended operation, (2) the analyses have been projected to the end of the period of extended operation, or (3) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

4.8.1 Summary of Technical Information in the Application

LRA Section 4.8 summarizes the evaluation of EQ of electrical equipment for the period of extended operation. The applicant stated that the EQ program is in compliance with the requirements of 10 CFR 50.49, and is being used to manage the aging of equipment in the EQ program during the current license term. The existing EQ program will be used to manage aging of equipment in the EQ program during the period of extended operation and includes provision to ensure that the qualification bases are maintained and the components do not exceed their qualified lives.

4.8.2 Staff Evaluation

The staff reviewed LRA Section 4.8 to confirm that pursuant to 10 CFR 54.21(c)(1)(iii), that the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

The staff reviewed Section 4.8 of the LRA and plant basis documents to determine whether the applicant provided adequate information to meet the requirements of 10 CFR 54.21(c)(1). For the electrical equipments identified in the EQ master list, the applicant used 10 CFR 54.21(c)(1)(iii) in its TLAA evaluation to demonstrate that the aging effects of EQ equipment will be adequately managed during the period of extended operation. The staff reviewed the EQ program to confirm whether it will assure that the electrical and I&C components covered under this program will continue to perform their intended functions consistent with the CLB for the period of extended operation. The staff's evaluation of the components' qualification focused on how the EQ program manages the aging effects to meet the requirements delineated in 10 CFR 50.49.

The staff conducted an audit of the information provided in LRA Section B.3.1.3 and program basis documents. On the basis of its audit, the staff finds that the EQ program, which the applicant claimed to be consistent with GALL AMP X.E1, "Environment Qualification of Electrical Components," is consistent. The staff finds that the EQ program is capable of programmatically managing the qualified life of components within the scope of the program for license renewal and that the continued implementation of the EQ program provides assurance that the aging effects will be managed and that components within the scope of the EQ program will continue to perform their intended functions for the period of extended operation.

4.8.3 UFSAR Supplement

The applicant provided a UFSAR Supplement summary description of its TLAA evaluation of environmental qualification of electrical equipment in LRA Section A.3.1.3. On the basis of its review of the UFSAR Supplement, the staff has determined that the summary description of the applicant's actions to address environmental qualification of electrical equipment is adequate.

4.8.4 Conclusion

The staff concludes that the applicant has demonstrated that, for EQ of electrical equipment, the effects of aging on the intended function(s) will be adequately managed for the period of extended operation, pursuant to 10 CFR 54.21(c)(1)(iii). The staff also concludes that the USAR supplement contains an appropriate summary description of the TLAA evaluation, as required by 10 CFR 54.21(d).

4.9 Conclusion

The staff reviewed the information in LRA Section 4, "Time-Limited Aging Analyses." On the basis of its review, the staff concludes that the applicant has provided an adequate list of TLAAs, as defined in 10 CFR 54.3. Further, the staff concludes that the applicant demonstrated that: (1) the TLAAs will remain valid for the period of extended operation, as required by 10 CFR 54.21(c)(1)(i); (2) the TLAAs have been projected to the end of the period of extended operation, as required by 10 CFR 54.21(c)(1)(ii); or (3) that the aging effects will be adequately managed for the period of extended operation, as required by 10 CFR 54.21(c)(1)(iii). The staff also reviewed the UFSAR Supplement for the TLAAs and found that the UFSAR Supplement contains descriptions of the TLAAs sufficient to satisfy the requirements of 10 CFR 54.21(d). In addition, the staff concludes that one plant-specific exemption is in effect that is based on TLAAs, and that the applicant has provided an adequate evaluation that justifies the continuation of this exemption for the period of extended operation as required by 10 CFR 54.21(c)(2).

With regard to these matters, the staff concludes that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB, and that any changes made to the CLB, in order to comply with 10 CFR 54.21(c), are in accordance with the Atomic Energy Act of 1954 and the NRC's regulations.

SECTION 5

REVIEW BY THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The NRC staff issued its safety evaluation report (SER) with open items related to the renewal of operating license for the Three Mile Island Nuclear Station, Unit – 1 (TMI-1) on March 13, 2009. On April 1, 2009, the applicant presented its license renewal application, and the staff presented its review findings to the Advisory Committee on Reactor Safeguards (ACRS) Plant License Renewal Subcommittee. The staff reviewed the applicant's comments on the SER and completed its review of the license renewal application. The staff's evaluation is documented in an SER that was issued by letter dated June 30, 2009.

During the 565th meeting of the ACRS held on September 10-12, 2009, the ACRS completed its review of the TMI-1 license renewal application and the NRC staff's SER. The ACRS documented its findings in a letter to the Commission dated September 28, 2009. A copy of this letter is provided on the following pages of this SER section.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

September 28, 2009

The Honorable Gregory B. Jaczko
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: REPORT ON THE SAFETY ASPECTS OF THE LICENSE RENEWAL APPLICATION FOR THE THREE MILE ISLAND NUCLEAR STATION, UNIT 1

During the 565th meeting of the Advisory Committee on Reactor Safeguards, September 10-12, 2009, we completed our review of the license renewal application for the Three Mile Island Nuclear Station, Unit 1 (TMI-1), and the final Safety Evaluation Report (SER) prepared by the NRC staff. Our Plant License Renewal Subcommittee also reviewed this matter during its meeting on April 1, 2009. During these reviews, we had the benefit of discussions with representatives of the NRC staff and the applicant, Exelon Generation Company, LLC (Exelon). We received and considered comments from a member of the public. We also had the benefit of the documents referenced. This report fulfills the requirement of 10 CFR 54.25 that the ACRS review and report on all license renewal applications.

CONCLUSION AND RECOMMENDATION

1. The programs established and committed to by the applicant to manage age-related degradation provide reasonable assurance that TMI-1 can be operated in accordance with its current licensing basis for the period of extended operation without undue risk to the health and safety of the public.

2. The application for renewal of the operating license of TMI-1 should be approved.

BACKGROUND AND DISCUSSION

TMI-1 is a two-loop Babcock & Wilcox pressurized water reactor with once-through steam generators and a large, dry, steel-lined, reinforced concrete containment. The current power rating of 2568 MWt includes a 1.3 percent power uprate that was implemented in 1988. The original TMI-1 steam generators are scheduled to be replaced in late 2009. In January 2008, AmerGen Energy Company, LLC, requested renewal of the TMI-1 operating license for 20 years beyond the current license term, which expires on April 19, 2014. On January 8, 2009, the TMI-1 operating license was transferred to Exelon Generation Company, LLC, which is the current applicant.

The staff documented in the final SER its review of the license renewal application and other information submitted by the applicant or obtained during two staff audits and an inspection conducted at the plant site, and a supplemental inspection at the Exelon headquarters offices.

The staff reviewed the completeness of the applicant's identification of structures, systems, and components (SSCs) that are within the scope of license renewal; the integrated plant assessment process; the applicant's identification of the plausible aging mechanisms associated with passive, long-lived components; the adequacy of the applicant's Aging Management Programs (AMPs); and the identification and assessment of time-limited aging analyses (TLAAs) requiring review.

The applicant identified the SSCs that fall within the scope of license renewal and performed an aging management review for these SSCs. The applicant will implement 38 AMPs for license renewal. These include 30 existing programs, seven new programs, and one existing plant-specific program to manage the aging of nickel alloy components and welds. A total of 24 AMPs, nine of which contain enhancements, are consistent with the guidance in the Generic Aging Lessons Learned (GALL) Report. Fourteen AMPs contain exceptions to approaches specified in the GALL Report. We reviewed these exceptions and agree with the staff that they are acceptable.

The applicant identified the systems and components requiring TLAAs and reevaluated them for the period of extended operation. The staff concluded that the applicant has provided an acceptable list of TLAAs, as defined in 10 CFR 54.3. Furthermore, the staff concluded that in all cases the applicant has met the requirements of the License Renewal Rule by demonstrating that the TLAAs will remain valid for the period of extended operation, or the TLAAs have been projected to the end of the period of extended operation, or the aging effects will be adequately managed for the period of extended operation. We concur with the staff's conclusion that the TMI-1 TLAAs have been properly identified and that the required criteria will be met for the period of extended operation.

The staff conducted two license renewal audits and one inspection at the TMI site. The audits verified the appropriateness of the scoping and screening methodology, aging management review, and TLAAs. The inspection verified that the license renewal requirements are appropriately implemented. Based on the audits and inspection, the staff concluded in the final SER that the proposed activities will adequately manage the aging of SSCs identified in the application and that the intended functions of these SSCs will be maintained during the period of extended operation. We agree with this conclusion.

In the 1990s, corrosion of the containment liner was detected in several locations behind and just above the moisture barrier at the containment floor. The corrosion was caused by leakage of borated water and degradation of the moisture barrier seal that allowed water to collect between the moisture barrier and the inner surface of the liner. The moisture barrier was replaced in 2007. At that time, the previous licensee inspected the entire periphery of the liner to a depth of approximately four to eight inches in the opened gap and confirmed that no corrosion extended below the moisture barrier sealing surface. The applicant has verified that the containment liner currently meets all design requirements, and all identified locations of the corrosion have been recorded. The applicant will perform weld repairs to restore the liner to its nominal thickness for all locations where the base metal thickness is reduced by more than 10%. These repairs will be performed during the 2009 outage to replace the steam generators.

We agree with the staff's conclusion that these corrective actions and continued monitoring through the ASME Section XI, Subsection IWE Program will provide adequate assurance of the liner integrity.

High-density spent fuel storage racks containing Boral panels were installed at TMI-1 in 1992. Different rack designs are used in two regions of the spent fuel pool. In Region 1, the racks have a water gap between adjacent storage cells that functions as a flux trap. In Region 2, there is no water gap between adjacent cells. The Boral panels in Region 1 have thinner sheathing than the panels in Region 2. Corrosion and blistering of Boral surveillance coupons were detected in 1997 and 2008. The largest blister was approximately 1-inch in diameter, 0.058-inch deep, and was filled with water. The previous licensee performed analyses to confirm that the largest blister would not reduce the neutron absorption capacity of the Boral or the neutron attenuation in the Region 1 water gaps, even if the blister were filled with gas. The staff concluded that the TMI-1 Water Chemistry Program and the Boral Surveillance Program will adequately manage the aging effects from Boral corrosion during the period of extended operation. The staff also stated that Interim Staff Guidance is currently being prepared to address the general topic of neutron absorbing materials in fuel storage racks. We agree that these programs will adequately manage the effects of Boral corrosion.

During the site AMP audit, the staff observed water in manholes which contain medium voltage cables that are important to safety. The staff identified water intrusion into underground cable ducts and manholes as a generic, current operating plant issue in Information Notice 2002-12, "Submerged Safety-Related Electrical Cables," and in Generic Letter 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients." The applicant stated that they will re-grade areas surrounding cable manholes, replace manhole lid gaskets, and refurbish cable vault French drains to minimize water intrusion. The staff will continue to address this issue through the Reactor Oversight Process during the current period of operation.

The license renewal application did not fully document TMI-1 plant-specific operating and maintenance experience for the five- to ten-year period that is recommended by the Nuclear Energy Institute (NEI) guideline NEI 95-10. Exelon originally referred to information in the Electric Power Research Institute (EPRI) report, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4," as a surrogate for TMI-1 plant-specific operating and maintenance experience from November 30, 2001 through December 31, 2004. Actual plant-specific operating and maintenance records were reviewed only for the period from January 1, 2005 through November 30, 2006. In response to questions raised during our interim review of the TMI-1 license renewal application and the associated NRC staff's SER with open items, the applicant completed a full review of the TMI-1 plant-specific operating experience for the five-year period ending November 30, 2006. The staff audited this operating experience during a supplemental inspection conducted in July 2009. We agree that the augmented plant-specific operating experience review appropriately supports the license renewal application.

We agree with the staff that there are no issues related to the matters described in 10 CFR 54.29(a)(1) and (a)(2) that preclude renewal of the operating license for TMI-1.

The programs established and committed to by Exelon provide reasonable assurance that TMI-1 can be operated in accordance with its current licensing basis for the period of extended operation without undue risk to the health and safety of the public. The Exelon application for renewal of the operating license for TMI-1 should be approved.

Dr. J. Sam Armijo did not participate in the Committee's deliberations regarding this matter.

Sincerely,

Mario V. Bonaca

Mario V. Bonaca
Chairman

REFERENCES

1. Memorandum from David L. Pelton, Chief, Projects Branch 1, Division of License Renewal, Office of Nuclear Reactor Regulation, to Edwin M. Hackett, Executive Director, Advisory Committee on Reactor Safeguards, "Advisory Committee on Reactor Safeguards Review of the Three Mile Island Nuclear Station, Unit 1, License Renewal Application - Safety Evaluation Report," July 1, 2009 (ML091400112 and ML091660470)

2. Memorandum from David L. Pelton, Chief, Projects Branch 1, Division of License Renewal, Office of Nuclear Reactor Regulation, to Edwin M. Hackett, Executive Director, Advisory Committee on Reactor Safeguards, "Advisory Committee on Reactor Safeguards Review of the Three Mile Island Nuclear Station, Unit 1, License Renewal Application - Safety Evaluation Report," July 1, 2009 (ML090760531 and ML090710604)

3. Letter from Michael P. Gallagher, Vice President, License Renewal, AmerGen Exelon Generation Company, LLC, to U.S. Nuclear Regulatory Commission, "Three Mile Island, Unit 1 License Renewal Application," January 8, 2008 (ML080220219)

4. Letter from Jay Robinson, Sr. Project Manager, Division of License Renewal, Office of Nuclear Reactor Regulation, to Michael P. Gallagher, Vice President License Renewal Projects, AmerGen Energy Company, LLC, "Audit Report Regarding the Three Mile Island Nuclear Station, Unit 1, License Renewal Application," November 24, 2008 (ML082880003)

5. Letter from Jay Robinson, Sr. Project Manager, Division of License Renewal, Office of Nuclear Reactor Regulation, to Michael P. Gallagher, Vice President License Renewal Projects, AmerGen Energy Company, LLC, "Scoping and Screening Audit Summary Regarding the Three Mile Island Nuclear Station, Unit 1, License Renewal Application," December 3, 2008 (ML083240245)

6. Letter from Richard Conte, Chief, Division of Reactor Safety, Region I, to Charles G. Pardee, Sr. Vice President and Chief Nuclear Officer, Exelon Generation Group, LLC, "Three Mile Island Nuclear Station Unit 1 – NRC License Renewal Inspection Report 05000289/2008010," March 10, 2009 (ML090690605)

7. Letter from Richard Conte, Chief, Division of Reactor Safety, Region I, to Charles G. Pardee, Sr. Vice President and Chief Nuclear Officer, Exelon Generation Group, LLC, "Three Mile Island Nuclear Station Unit 1 – NRC License Renewal Inspection Report 05000289/2008010," August 19, 2009 (ML092310405)

8. U.S. Nuclear Regulatory Commission, NUREG-1801, Volumes 1 & 2, Revision 1, "Generic Aging Lessons Learned Report," September 2005 (ML052700171)

9. U. S. Nuclear Regulatory Commission, Information Notice 2002-12, "Submerged Safety-Related Electrical Cables," March 21, 2002 (ML020790238)

10. U. S. Nuclear Regulatory Commission, Generic Letter 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," February 7, 2007 (ML070360665)

11. Letter from Alex Marion, Senior Director, Engineering, Nuclear Energy Institute, to P. T. Kuo, Program Director, License Renewal and Environmental Impacts, Division of Regulatory Improvement Programs, Office of Nuclear Reactor Regulations, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 – The License Renewal Rule," NEI 95-10, Revision 6, June 2005 (ML051860406)

12. Nuclear Energy Institute, "Industry Guidelines for Implementing the Requirements of 10 CFR Part 54, - The License Renewal Rule, "NEI 95-10, "Revision 6, June 2005 (ML051860406)

13. Electric Power Research Institute, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4," Technical Report 1010639, January 2006

14. Written comments from Ms. Marjorie Aamodt, a member of the public, regarding Three Mile Island, Unit 1, License Renewal Application, April 1, 2009 (ML092520228)

SECTION 6

CONCLUSION

The staff of the U.S. Nuclear Regulatory Commission (the staff), reviewed the license renewal application (LRA) for the Three Mile Island Nuclear Station, Unit 1 (TMI-1), in accordance with the NRC regulations and NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," dated September 2005. Title 10, Section 54.29, of the *Code of Federal Regulations* (10 CFR 54.29) provides the standards for issuance of a renewed license.

On the basis of its review of the LRA, the staff concludes that the requirements of 10 CFR 54.29(a) have been met.

The staff notes that any requirements of Subpart A of 10 CFR Part 51 are documented in Supplement 37 to NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Three Mile Island Nuclear Station, Unit-1 Final Report," dated June 2009.

Appendix A

APPENDIX A

Commitments For License Renewal Of TMI-1

During the review of the Three Mile Island Nuclear Station, Unit 1 (TMI-1), license renewal application (LRA) by the staff of the U.S. Nuclear Regulatory Commission (staff), Amergen Energy Company, LLC (Amergen) the applicant, made commitments related to aging management programs (AMPs) to manage aging effects of structures and components (SCs) prior to the period of extended operation. The following table lists these commitments, along with the implementation schedules and the sources of the commitment.

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF TMI-1			
No.	**Commitment**	**Implementation Schedule**	**Source**
1	The ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD Program is being implemented.	Ongoing	January 08, 2008 Letter
2	The Water Chemistry Program will be enhanced to incorporate the continuous monitoring of sodium in steam generator blowdown, making it consistent with EPRI 1008224, Pressurized Water Reactor Secondary Water Chemistry Guidelines, Revision 6.	Prior to the period of extended operation	January 08, 2008 Letter
3	The Reactor Head Closure Studs Program is being implemented. The program will be enhanced to select an alternate stable lubricant that is compatible with the fastener material and the environment.	Prior to the period of extended operation	January 08, 2008 Letter October 30, 3008 Letter
4	The Boric Acid Corrosion Program is being implemented.	Ongoing	January 08, 2008 Letter
5	Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors	Ongoing	January 08, 2008 Letter
6	The Flow-Accelerated Corrosion Program is being implemented.	Ongoing	January 08, 2008 Letter
7	The Bolting Integrity Program is being implemented.	Ongoing	January 08, 2008 Letter
8	The Steam Generator Tube Integrity Program is being implemented.	Ongoing	January 08, 2008 Letter
9	The Open-Cycle Cooling Water Program will be enhanced by adding a new river water chemical system to treat the river water systems for biofouling.	Prior to the period of extended operation	January 08, 2008 Letter
10.	The Closed-Cycle Cooling Water Program will be enhanced to include a one-time inspection of selected components in stagnant flow areas to confirm the absence of aging effects resulting from exposure to closed cycle cooling water. Also, a one-time inspection of selected CCCW chemical mix tanks and associated piping components will be performed to verify corrosion has not occurred on the interior surfaces of the tanks and associated piping components.	Program and one-time inspections to be implemented prior to the period of extended operation	January 08, 2008 Letter May 29, 2009 Letter

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF TMI-1			
No.	**Commitment**	**Implementation Schedule**	**Source**
11.	The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program will be enhanced to include visual inspection of rails in the rail system for loss of material due to wear, and visual inspection of structural bolting for loss of material. Acceptance criteria will be enhanced to require that significant loss of material due to wear will be evaluated or corrected to ensure the intended function of the crane or hoist is not impacted.	Prior to the period of extended operation	January 08, 2008 Letter
12.	The Compressed Air Monitoring Program will be enhanced to include air quality testing for dew point, particulates, lubricant content, and contaminants to ensure that the contamination standards of ANSI/ISAS7.0.01-1996, paragraph 5 are met. In addition the program will be enhanced to include air quality sampling on a representative sampling of headers on a yearly basis in accordance with the guidelines of ASME OM-S/G-1998, Part 17 and EPRI TR-108147.	Prior to the period of extended operation	January 08, 2008 Letter
13.	The Fire Protection Program will be enhanced to include additional inspection criteria for degradation of fire barrier walls, ceilings, and floors, and specific fuel supply line inspection criteria for diesel driven fire pumps during tests. In addition, implementing surveillance procedures for halon and carbon dioxide suppression systems will specifically require inspection for corrosion, mechanical damage, or damage to dampers, and will include acceptance criteria stating that detected signs of corrosion or mechanical damage be evaluated, with corrective action taken as appropriate.	Prior to the period of extended operation	January 08, 2008 Letter October 20, 2008 Letter
14.	The Fire Water System Program will be enhanced to include sprinkler head testing in accordance with NFPA 25, "Inspection, Testing and Maintenance of Water-Based Fire Protection Systems." Samples will be submitted to a testing laboratory prior to being in service 50 years. This testing will be repeated at intervals not exceeding 10 years. Prior to the period of extended operation, the program will be enhanced to include periodic non-intrusive wall thickness measurements of selected portions of the fire water system at an interval not to exceed every 10 years. The initial wall thickness inspections will be performed prior to the period of extended operation.	Prior to the period of extended operation, and Inspection schedule identified in commitment	January 08, 2008 Letter May 29, 2009 Letter
15.	The Aboveground Steel Tanks Program will be enhanced to include one-time thickness measurements of the bottom of the Condensate Storage Tanks, which are supported on concrete foundations. The measurements will be taken to ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation. The program will also be enhanced to inspect the sealant at the tank-foundation interface.	Program and one-time inspections to be implemented prior to the period of extended operation	January 08, 2008 Letter May 29, 2009 Letter

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF TMI-1			
No.	**Commitment**	**Implementation Schedule**	**Source**
16.	The Fuel Oil Chemistry Program will be enhanced to include: 1. The analysis of new fuel oil for specific or API gravity, kinematic viscosity, and water and sediment prior to filling the fuel oil storage tanks followed by full spectrum analysis within 31 days after the addition of the fuel oil into the fuel oil storage tanks. 2. The determination of water and sediment and particulate contamination in accordance with ASTM standards. 3. The analysis for bacteria in new and stored fuel oil. 4. The addition of biocides, stabilizers, or corrosion inhibitors as determined by fuel oil analysis activities. 5. Activities to periodically drain water and sediment from tank bottoms, and, activities to periodically drain, clean, and inspect fuel oil tanks. 6. Manual sampling in accordance with ASTM standards and required frequencies. 7 The use of ultrasonic techniques for determining tank bottom thicknesses should there be any evidence of loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion, and fouling found during visual inspection activities. 8. To confirm the absence of any significant aging effects, one-time inspections will be performed on the following tanks: A. Station Blackout Diesel Clean Fuel Tank. 2. Station Blackout Diesel Day Tank.	Program and one-time inspections to be implemented prior to the period of extended operation	January 08, 2008 Letter May 29, 2009 Letter
17.	The Reactor Vessel Surveillance Program will be enhanced to address maintenance of the TMI-1 cavity dosimetry exchange schedule. The program will also be enhanced to clarify that, if future plant operations exceed the limitations or bounds specified in Regulatory Position 1.3 of RG 1.99, Rev. 2, the impact of plant operation changes on the extent of reactor vessel embrittlement will be evaluated and the NRC will be notified.	Prior to the period of extended operation	January 08, 2008 Letter

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF TMI-1			
No.	**Commitment**	**Implementation Schedule**	**Source**
18.	The One-Time Inspection Program used to provide reasonable assurance that an aging effect is not occurring, or that the aging effect is occurring slowly enough to not affect a components intended function during the period of extended operation, and therefore will not require additional aging management. The program will be credited for cases where either (a) an aging effect is not expected to occur but there is insufficient data to completely rule it out, (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected, or (c) the characteristics of the aging effect include a long incubation period. This program will be used for the following: 1. To confirm the effectiveness of the Water Chemistry program to manage the loss of material, cracking, and the reduction of heat transfer aging effects for steel, stainless steel, copper alloy, nickel alloy, and aluminum alloy in treated water, steam, and reactor coolant environments. 2. To confirm the effectiveness of the Fuel Oil Chemistry program to manage the loss of material aging effect for steel, stainless steel, and copper alloy in a fuel oil environment. 3. To confirm the effectiveness of the Lubricating Oil Analysis program to manage the loss of material and the reduction of heat transfer aging effects for steel, stainless steel, copper alloy, and aluminum alloy in a lubricating oil environment. 4. To confirm the loss of material aging effect is insignificant for stainless steel and copper alloy in an air/gas – wetted environment. Inspection methods will include visual examination or volumetric examinations. Acceptance criteria will be in accordance with industry guidelines, codes, and standards. The One-Time Inspection program provides for the evaluation of the need for follow-up examinations to monitor the progression of aging if age-related degradation is found that could jeopardize an intended function before the end of the period of extended operation. Should aging effects be detected, the program triggers actions to characterize the nature and extent of the aging effect and determines what subsequent monitoring is needed to ensure intended functions are maintained during the period of extended operation.	Program and one-time inspections to be implemented prior to the period of extended operation	January 08, 2008 Letter May 29, 2009 Letter
19.	The Selective Leaching of Materials Program will be used to manage the loss of material due to selective leaching. The program includes inspection of a representative sample of susceptible components to determine if loss of material due to selective leaching is occurring. One-time inspections will include visual examinations, supplemented by hardness tests, and other examinations, as required. If selective leaching is found, the condition will be evaluated to determine the need to expand inspection scope.	Program and one-time inspections to be implemented prior to the period of extended operation	January 08, 2008 Letter May 29, 2009 Letter

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF TMI-1			
No.	Commitment	Implementation Schedule	Source
20.	The Buried Piping and Tanks Inspection Program will be enhanced to include: 1. Inspection of buried stainless steel piping and components prior to entering the period of extended operation. 2. Inspection of buried cast iron, carbon steel, concrete-coated carbon steel, and stainless steel piping and components within ten years after entering the period of extended operation. 3. Internal inspection and UT of the D.G. Fuel Storage 30,000 Gallon Tank prior to the period of extended operation, and within ten years after entering the period of extended operation	Prior to the period of extended operation, Inspection schedule identified in commitment	January 08, 2008 Letter May 29, 2009 Letter
21.	The External Surfaces Monitoring Program will be used to manage aging effects through visual inspection of external surfaces for evidence of hardening and loss of strength and loss of material. The program directs visual inspections that are performed during system walkdowns. The program consists of periodic visual inspection of components such as piping, piping components, ducting, and other components within the scope of license renewal. Visual inspections may be augmented by physical manipulation to detect hardening and loss of strength of elastomers.	Prior to the period of extended operation	January 08, 2008 Letter
22.	The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program will be used to manage cracking due to stress corrosion cracking; hardening and loss of strength due to elastomer degradation; loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion and fouling; and reduction of heat transfer due to fouling. The program includes provisions for visual inspections of the internal surfaces and volumetric testing of components not managed under any other aging management program. Visual inspections may be augmented by physical manipulation to detect hardening and loss of strength of elastomers.	Prior to the period of extended operation	January 08, 2008 Letter October 20, 2008 Letter
23.	The Lubricating Oil Analysis Program is being implemented.	Ongoing	January 08, 2008 Letter
24.	The ASME Section XI, Subsection IWE Program is being implemented.	Ongoing	January 08, 2008 Letter
25.	The ASME Section XI, Subsection IWL Program is being implemented.	Ongoing	January 08, 2008 Letter
26.	The ASME Section XI, Subsection IWF Program is being implemented.	Ongoing	January 08, 2008 Letter
27.	The 10 CFR Part 50, Appendix J Program is being implemented.	Ongoing	January 08, 2008 Letter

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF TMI-1			
No.	**Commitment**	**Implementation Schedule**	**Source**
28.	Existing program is credited. The program will be enhanced to include: 1. Service Building. 2. UPS Diesel Building. 3. Mechanical Draft Cooling Tower Structure. 4. Miscellaneous Yard Structures: Storm Drainage and Flood Control Structure, including the structural platform; Duct banks; Manholes; Foundations for Condensate Storage Tank, Borated Water Storage Tank including the Borated Water Storage Tank tunnel, Altitude Tank, Emergency Diesel Fuel Oil Storage Tank. 5. Penetration seals which perform a license renewal intended function for an in-scope structure. 6. Monitoring of the intake canal for loss of material and loss of form. 7. Monitoring of electrical panels, junction boxes, instrument panels, and conduits for loss of material due to corrosion. 8. Monitoring of ground water chemistry by periodically sampling, testing, and analysis of ground water to confirm that the environment remains non-aggressive for buried reinforced concrete. 9. Monitoring of reinforced concrete submerged in raw water associated with intake screen and pumphouse, circulating water pump house, mechanical draft cooling tower structures, natural draft cooling tower basins, and circulating water tunnel. 10. Monitoring of vibration isolators, associated with component supports other than those covered by ASME XI, Subsection IWF, for reduction or loss of isolation function. 11. Monitoring of HVAC duct supports for loss of material. 12. Parameters monitored will be enhanced to include plausible aging effects and mechanisms. 13. Monitoring of concrete structures for a reduction in anchor capacity due to local concrete degradation. This will be accomplished by visual inspection of concrete surfaces around anchors for cracking, and spalling. 14. Revised acceptance criteria to provide details specified in ACI 349.3R-96.	Prior to the period of extended operation	January 08, 2008 Letter August 19, 2008 Letter May 29, 2009 Letter
29.	The Protective Coating Monitoring and Maintenance Program is being implemented.	Ongoing	January 08, 2008 Letter
30.	The Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program will be used to manage aging of non-EQ cables and connections during the period of extended operation. A representative sample of accessible cables and connections located in adverse localized environments will be visually inspected at least once every 10 years for indications of accelerated insulation aging such as embrittlement, discoloration, cracking, or surface contamination. An adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified service environment for the cable or connection.	Program and first inspections to be implemented prior to the period of extended operation	January 08, 2008 Letter May 29, 2009 Letter

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF TMI-1			
No.	**Commitment**	**Implementation Schedule**	**Source**
31.	The Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits Program will be enhanced to manage the aging of the cable and connection insulation of the in scope radiation monitoring and nuclear instrumentation circuits in the Radiation Monitoring and Nuclear Instrumentation and Incore Monitoring Systems. The in scope radiation monitoring and nuclear instrumentation circuits are sensitive instrumentation circuits with low-level signals and are located in areas where the cables and connections could be exposed to adverse localized environments caused by heat, radiation, or moisture. These adverse localized environments can result in reduced insulation resistance causing increases in leakage currents. Calibration testing and performance monitoring are currently being performed for in scope radiation monitoring circuits. Direct cable testing will be performed as an enhancement to ensure that the cable and connection insulation resistance is adequate for the nuclear instrumentation circuits to perform their intended functions.	Program, first tests and calibrations, and first assessment of calibration results to be implemented prior to the period of extended operation	January 08, 2008 Letter May 29, 2009 Letter
32.	The Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements will be used to manage the aging effects and mechanisms of non-EQ, in scope inaccessible medium voltage cables. These cables may at times be exposed to significant moisture simultaneously with significant voltage. The TMI-1 cables in the scope of this aging management program will be tested using a proven test for detecting deterioration of the insulation system due to wetting, such as power factor, partial discharge, or polarization index, as described in EPRI TR-103834-P1-2, or other testing that is state-of-the-art at the time the test is performed. The cables will be tested at least once every 10 years. Manholes associated with the cables included in this aging management program will be inspected for water collection initially at least twice a year, in accordance with existing practices, and drained as required. The frequency will be adjusted based on inspection results recognizing that the objective of the inspections, as a preventive action, is to keep the cables infrequently submerged, thereby minimizing their exposure to significant moisture. The maximum time between inspections will be two years, which is in alignment with the recommended frequency in NUREG-1801, AMP XI.E3.	Program and first tests and inspections to be implemented prior to the period of extended operation	January 08, 2008 Letter October 30, 2008 Letter May 29, 2009 Letter

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF TMI-1			
No.	**Commitment**	**Implementation Schedule**	**Source**
33.	The Metal Enclosed Bus Program will be enhanced to include the following inspection criteria: 1. The internal portion of the metal enclosed bus will be visually inspected for cracks, corrosion, foreign debris, excessive dust build-up and evidence of moisture intrusion. 2. The bus insulation will be visually inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. 3. The internal bus supports will be visually inspected for structural integrity and signs of cracks. The program will also be enhanced to perform internal visual inspections on the 480V Metal Enclosed Bus and the Station Black Out Metal Enclosed Bus.	Program and first inspections and tests to be implemented prior to the period of extended operation	January 08, 2008 Letter May 29, 2009 letter
34.	The Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program will be used to manage the aging effects of metallic parts of non-EQ electrical cable connections within the scope of license renewal during the period of extended operation. A representative sample of non-EQ electrical cable connections will be selected for one-time testing considering application (medium and low voltage), circuit loading (high loading) and location, with respect to connection stressors. The technical basis for the sample selected is to be documented. The specific type of test performed will be a proven test for detecting loose connections, such as thermography or contact resistance measurement, as appropriate to the application.	Program and one-time testing to be implemented prior to the period of extended operation	January 08, 2008 Letter May 29, 2009 Letter
35.	The Nickel Alloy Aging Management Program will implement applicable Bulletins, Generic Letters, and staff-accepted industry guidelines.	Ongoing	January 08, 2008 Letter
36.	The PWR Vessel Internals Program will commit to the following activities: 1. Participate in the industry programs for investigating and managing aging effects on reactor internals. 2. Evaluate and implement the results of the industry programs as applicable to the reactor internals. 3. Upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	Prior to the period of extended operation	January 08, 2008 Letter
37.	The Metal Fatigue of Reactor Coolant Pressure Boundary Program will be enhanced to add the statement: "Acceptable corrective actions include: reanalysis of the component to demonstrate that the design code limit will not be exceeded prior to or during the period of extended operation; repair of the component; replacement of the component, or other methods approved by the NRC." In addition, the program will be enhanced to require a review of additional reactor coolant pressure boundary locations if the usage factor for one of the environmental fatigue sample locations approaches its design limit.	Prior to the period of extended operation	January 08, 2008 Letter
38.	The Concrete Containment Tendon Prestress Program is being implemented.	Ongoing	January 08, 2008 Letter

APPENDIX A: LONG TERM COMMITMENTS FOR LICENSE RENEWAL OF TMI-1			
No.	**Commitment**	**Implementation Schedule**	**Source**
39.	The Environmental Qualification of Electrical Components program is being implemented.	Ongoing	January 08, 2008 Letter
40.	New Once Through Steam Generators will be installed.	Prior to the period of extended operation	January 08, 2008 Letter
41.	Revised pressure-temperature (P-T) limits and low-temperature overpressurization (LTOP) limits for a 60-year operating life have been prepared and will be submitted to the NRC for approval.	Prior to the period of extended operation or prior to exceeding 29 EFPY, whichever comes first	LRA Section 4.2.5
42.	Prior to the period of extended operation, TMI-1 will restore the reactor building liner to its nominal plate thickness by weld repair for the previously identified corroded areas of the reactor building liner where the thickness of the base metal is reduced by more than 10% of the nominal plate thickness.	Prior to the period of extended operation	October 30, 2008 Letter
43.	Boral test coupon surveillance will continue through the period of extended operation	Ongoing	November 12, 2008 Letter

Appendix B

APPENDIX B

Chronology

This Appendix contains a chronological listing of the routine correspondence between the staff of the U.S. Nuclear Regulatory Commission (NRC or the staff) and the Amergen Energy Company, LLC (Amergen or the applicant), and other correspondence regarding the staff's reviews of the Three Mile Island Nuclear Station, Unit 1 (TMI-1), Docket Number 50-289, license renewal application (LRA).

January 03, 2008	Three Mile Island Nuclear Station, Unit 1, Thirty-Three License Renewal Drawings. (Accession No. ML080220572)
January 03, 2008	Three Mile Island Nuclear Station, Unit 1, Thirty-Nine License Renewal Drawings. (Accession No. ML080220570)
January 03, 2008	Three Mile Island Nuclear Station, Unit 1, Forty License Renewal Drawings. (Accession No. ML080220569)
January 03, 2008	Three Mile Island Nuclear Station, Unit 1, Forty-One License Renewal Drawings. (Accession No. ML080220568)
January 03, 2008	Three Mile Island Nuclear Station, Unit 1, Four License Renewal Drawings. (Accession No. ML080220567)
January 08, 2008	Letter Transmitting Three Mile Island Nuclear Station, Unit 1 Application for Renewed Operating License. (Accession No. ML080220219)
January 08, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Table of Contents through Table 3.6.2-1. (Accession No. ML080220243)
January 08, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Section 3.0 Aging Management Review Results through Table 2.5-1, Electrical Commodity Groups. (Accession No. ML080220248)
January 08, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Section 3.4 Aging Management of Steam and Power Conversion System through Appendix A. (Accession No. ML080220252)
January 08, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Appendix B through Environmental Report Page 2-59. (Accession No. ML080220255)
January 08, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Environmental Report Page 2-60 through Page A-10. (Accession No. ML080220257)
January 08, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Environmental Report Appendix B Page B-1 through Appendix D Page D-8. (Accession No. ML080220261)
January 08, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Environmental Report Appendix E, Table of Contents through Page E-390. (Accession No. ML080220282)

January 08, 2008	Three Mile Island Nuclear Station, Unit 1, Updated Final Safety Analysis Report, Section 4.0, Table of Contents through Section 6, Figure 6.B-20. (Accession No. ML080220548)
January 08, 2008	Three Mile Island Nuclear Station, Unit 1, Updated Final Safety Analysis Report, Section 7.0, Table of Contents through Section 11, Figure 11.5-1. (Accession No. ML080220562)
January 08, 2008	Three Mile Island Nuclear Station, Unit 1, Updated Final Safety Analysis Report, Appendix 11A through End. (Accession No. ML080220563)
January 25, 2008	Letter to R. West, Receipt and Availability of the License Renewal Application for the Three Mile Island Nuclear Station, Unit 1. (Accession No. ML073310128)
February 14, 2008	Forthcoming Public Information Sessions for the U.S. Nuclear Regulatory Commission Staff to Discuss the License Renewal Process for the Three Mile Island Nuclear Station, Unit 1, License Renewal Application Review.(Accession No. ML080380505)
February 26, 2008	Press Release-I-08-006: NRC to Discuss Review of License Renewal Application for Three Mile Island 1 Nuclear Power Plant. (Accession No. ML080570365)
March 4, 2008	License Renewal Process Overview Three Mile Island Nuclear Station, Unit 1, Public Meeting Handout 03/04/2008. (Accession No. ML080670098)
March 10, 2008	Letter to Michael Gallagher: Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding the Application from Amergen Energy Company, LLC, For Renewal of the Operating License for Three Mile Island Nuclear Station, Unit 1. (Accession No. ML080370352)
March 10, 2008	US NRC Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License No. DPR-50 for an Additional 20-Year Period, Amergen Energy Company, LLC, Three Mile Island Nuclear Station, Unit 1. (Accession No. ML080370473)
March 10, 2008	Press Release-08-050: NRC Announces Opportunity to Request Hearing on License Renewal Application for Three Mile Island Nuclear station, Unit 1. (Accession No. ML080700892)
March 21, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, License Renewal Application Online Reference Portal. (Accession No. ML080710465)
March 24, 2008	Letter to Michael Gallagher: Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process for License Renewal for the Three Mile Island Nuclear Station, Unit 1. (Accession No. ML080780085)

March 24, 2008	Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process for License Renewal for the Three Mile Island Nuclear Station, Unit 1. (Accession No. ML080840397)
March 26, 2008	Notice of Meeting on May 01, 2008 with AmerGen Energy Company, LLC, to Discuss the Environmental Scoping Process for the Three Mile Island Nuclear Station, Unit 1, License Application Renewal Application Review. (Accession No. ML080800502)
March 31, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, License Renewal Application Online Reference Portal. (Accession No. ML080930301)
March 31, 2008	Letter from Michael Gallagher: Editorial Corrections to the Three Mile Island Nuclear Station, Unit 1, License Renewal Application Environmental Report. (Accession No. ML080930302)
April 01, 2008	Letter to Michael Gallagher: Site Audit Needs List, Three Mile Island Nuclear Station, Unit 1, License Renewal Application. (Accession No. ML080840029)
April 03, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear, Unit 1, License Renewal Application, Selected Environmental Report References. (Accession No. ML081420193)
April 04, 2008	Letter to David Densmore: Request for List of State Protected Species within the Area Under Evaluation for the Three Mile Island Nuclear Station, Unit 1, LRA Review. (Accession No. ML080840027)
April 08, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Corrections to the License Renewal Application. (Accession No. ML081010205)
April 09, 2008	Letter to the Honorable Raymond Halbritter: Request for Scoping Comments Concerning the Three Mile Island Nuclear Station, Unit 1, License Renewal Application Review by the Federally Recognized Tribes. (Accession No. ML080980572)
April 15, 2008	Letter to Chris Firestone, Pennsylvania Department of Conservation and Natural Resources: Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Request for List of State Habitats within the Area Under Evaluation. (Accession No. ML080930247)
April 15, 2008	Letter to Charlene Dwin Vaughn, Office of Federal Agency Programs: Three Mile Island Nuclear Station, Unit 1, License Renewal Application Review. (Accession No. ML080930296)
April 15, 2008	Letter to Christopher Urban, Pennsylvania Fish and Boat Commission: Request for List of State Protected Species with the area under Evaluation for the Three Mile Island Nuclear Station, Unit 1, License Renewal Application. (Accession No. ML080930486)

April 15, 2008	Letter to Rachel Diamond, Pennsylvania Department of Environmental Protection: Three Mile Island Nuclear Station, Unit 1, License Renewal Application Review. (Accession No. ML080930617)
April 15, 2008	Letter to Michael G. Brownell, Susquehanna River Basin Commission; Three Mile Island Nuclear Station, Unit 1, License Renewal Application Review. (Accession No. ML080930632)
April 15, 2008	Letter to Christopher Urban, Pennsylvania Fish and Boat Commission: Request for List of State Protected Species with the area under Evaluation for the Three Mile Island Nuclear Station, Unit 1, License Renewal Application. (Accession No. ML080930247)
April 15, 2008	Letter to James Leigey, Pennsylvania Game Commission: Request for List of State protection Species Within the area under Evaluation for the Three Mile Island Nuclear Station, Unit 1, License Renewal Application Review. (Accession No. ML080930178)
April 15, 2008	Letter to Jean Cutler, Bureau for Historic Preservation: Three Mile Island Nuclear Station, Unit 1, License Renewal Application Review. (Accession No. ML080930380)
April 21, 2008	Letter from Sherry White, Stockbridge-Munsee Tribal Historic Preservation Office Regarding the Three Mile Island Nuclear Station, Unit 1, License Renewal Application. (Accession No. ML081280309)
April 23, 2008	Letter from Susquehanna River Basin Commission to M. Gallagher, AmerGen, regarding the Three Mile Island Nuclear Station, Unit 1, License Renewal Application. (Accession No. ML081280308)
April 23, 2008	Letter from U.S. Fish and Wildlife Service: Three Mile Island Nuclear Station, Unit 1, License Renewal Application Review. (Accession No. ML081280307)
May 01, 2008	Transcript of the Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Afternoon Public Scoping Meeting on April 1, 2008 in Middletown, Pennsylvania. Pages 1-80. (Accession No. ML081300739)
May 01, 2008	Transcript of the Three Mile Island Nuclear Station, Unit 1, License Renewal Application Review, Environmental Public Scoping Meeting, May 01, 2008, Pages 1-27. (Accession No. ML081300749)
May 01, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Environmental Scoping Meeting Written Comments. (Accession No. ML081330183)
May 01, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Environmental Scoping Meeting Handouts and Slides. (Accession No. ML081330185)
May 02, 2008	Summary of Public Meetings Related to the License Renewal Process for the Three Mile Island Nuclear Station, Unit 1, License Renewal Application. (Accession No. ML081000290)

May 13, 2008	Three Mile Island Nuclear Station, Unit 1, Environmental Scoping Comment E-Mail. (Accession No. ML081430103)
May 13, 2008	Comment (1) of Linda Braasch on Behalf of Citizens of Pennsylvania, Opposing Re-Licensing of Three Mile Island Nuclear Station, Unit 1. (Accession No. ML081500158)
May 14, 2008	Letter from James R. Leigey, Pennsylvania Game Commission Regarding State Protected Species Review for Three Mile Island Nuclear Station, Unit 1, License Renewal. (Accession No. ML081500671)
May 19, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, May 19, 2008 Draft Request for Additional Information, For Sections 4.2 and 4.4. (Accession No. ML081710470)
May 21, 2008	Request for Additional Information Regarding Severe Accident Mitigation Alternatives for Three Mile Island Nuclear Station, Unit 1, License Renewal Application. (Accession No. ML081330714)
May 22, 2008	Summary of May 01, 2008 Public Environmental Scoping Meetings Related to the Review of the Three Mile Island Nuclear Station, Unit 1, License Renewal Application. (Accession No. ML081360648)
May 28, 2008	Letter from David J. Allard, Pennsylvania Department of Environmental Protection, Scoping Letter Regarding Three Mile Island Nuclear Station, Unit 1, License Renewal Application. (Accession No. ML081500598)
May 29, 2008	Comment (1) of Mary Osborn Onassiai on Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Environmental Impact Statement. (Accession No. ML081690678)
May 30, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Environmental Impact Statement. (Accession No. ML081580174)
May 30, 2008	Comment (2) of Michael G. Browne on Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Environmental Impact Statement. (Accession No. ML081690679)
June 03, 2008	Letter from Christopher A. Urban, Pennsylvania Fish and Boat Commission, Species Impact Review for Three Mile Island Nuclear Station, Unit 1 License Renewal Application. (Accession No. ML081610104)
June 10, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Transmittal of License Renewal Application Post-Audit Environmental Information. (Accession No. ML082110251)
June 10, 2008	Three Mile Island Nuclear Station, Unit 1, Enclosure A - Post Audit Environmental Information - Index through Audit Question ENV-070, Monthly Report on the Meteorological Monitoring Program, February 2007. (Accession No. ML082110252)

June 10, 2008	Three Mile Island Nuclear Station, Unit 1, Enclosure A - Post Audit Environmental Information - Question ENV-070, Monthly Report on the Meteorological Monitoring Program, March 2007 through End. (Accession No. ML082110253)
June 12, 2008	Summary Of Conference Call With Amergen Energy Company, LLC, TO Discuss The Severe Accident Mitigation Alternatives Requests For Additional Information For Three Mile Island Nuclear Station, Unit 1, License Renewal Application. (Accession No. ML081560666)
July 17, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML082040144)
July 23, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Summary of June 5, 2008 Conference Call Between USNRC and AmerGen to Discuss Draft Requests for Additional Information for Sections 4.2 and 4.4. (Accession No. ML081780006)
August 01, 2008	Summary of Site Audit Related to the Review of the License Renewal Application for Three Mile Island Nuclear Station, Unit 1. (Accession No. ML081420398)
August 05, 2008	Summary of July 17, 2008 Telephone Conference Call Between the NRC and AmerGen Energy Company, LLC., Concerning Follow-up Questions Pertaining to Three Mile Island Nuclear Station, Unit 1 License Renewal Environmental Review and Site Audit. (Accession No. ML082120727)
August 05, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Post-Audit Environmental Information. (Accession No. ML082200589)
August 08, 2008	Issuance of Environmental Scoping Summary Report Associated with the Staff's Review of the Application by AmerGen Energy Company, LLC, for Renewal of the Operating License for Three Mile Island Nuclear Station, Unit 1. (Accession No. ML081920230)
August 22, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Request for Additional Information, License Renewal Application, Section 2.1.5.2. (Accession No. ML082190781)
August 20, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Request for Additional Information, License Renewal Application, Sections 2.3.3 & 2.3.4. (Accession No. ML082180499)
August 20, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Request for Additional Information, License Renewal Application, Sections 4.2 and 4.4. (Accession No. ML ML082170046)
August 22, 2008	Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Summary of June 25, 2008 Conference Call with Amergen Energy Company to Discuss Draft RAIs, for LRA Sections 2.2, 2.3, 2.4, & 2.5. (Accession No. ML082180006)

August 22, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Request for Additional Information, License Renewal Application Sections 2.3.3.10, 2.4 & 2.5. (Accession No. ML082200032)
September 2, 2008	Letter to Mr. Charles G. Pardee: Three Mile Island Nuclear Station, Unit1, Mid Cycle Performance Review and Inspection Plan. (Accession No. ML082470553)
September 8, 2008	Three Mile Island Nuclear Station, Unit 1, Summary of Conference Call with Amergen Energy Company, LLC, to discuss responses to Severe Accident Mitigation Alternatives Request for Additional Information. (Accession No. ML082340226)
September 8, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML082550079)
September 10, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML082560178)
September 16, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML082630030)
September 19, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML082670359)
September 29, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Request for Additional Information, License Renewal Application, Appendix B, Aging Management Programs (Accession No. ML082490089)
September 30, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Request for Additional Information, License Renewal Application, Time Limited Aging Analysis (Accession No. ML082520573)
October 07, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Request for Additional Information, License Renewal Application, Appendix B, Aging Management Programs (Accession No. ML082520020)
October 16, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Request for Additional Information, License Renewal Application, Aging Management Review Results (Accession No. ML082520614)
October 20, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Request for Additional Information, License Renewal Application, Boral Neutron Absorbing Material in Spent Fuel Pool Racks (Accession No. ML082520614)

October 20, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML082960137)
October 23, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML083020406)
October 30, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML083080376)
November 3, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Supplemental Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML083110181)
November 12, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML083190038)
November 12, 2008	Letter from Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Response to NRC Request for Additional Information Related to License Renewal Application. (Accession No. ML083190039)
November 17, 2008	Three Mile Island Nuclear Station, Unit 1, Summary of Conference Call with Amergen Energy Company, LLC, to discuss responses to Request for Additional Information. (Accession No. ML083090053)
November 24, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, Request for Additional Information, License Renewal Application, Sections 2.3 and 2.4. (Accession No. ML083170038)
November 24, 2008	Letter to Michael Gallagher: Three Mile Island Nuclear Station, Unit 1, License Renewal Application, Aging Management Programs, Audit Summary Report. (Accession No. ML082880003)
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Appendix C

APPENDIX C

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Appendix D

APPENDIX D

References

This appendix contains a listing of the references used in the preparation of the Safety Evaluation Report (SER) prepared during the review of the license renewal application (LRA) for Three Mile Island Nuclear Station, Unit 1 (TMI-1), Docket Number 50-289.

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NRC FORM 335 (9-2004) NRCMD 3.7 — U.S. NUCLEAR REGULATORY COMMISSION **BIBLIOGRAPHIC DATA SHEET** *(See instructions on the reverse)*	1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.) NUREG-1928
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8. PERFORMING ORGANIZATION - NAME AND ADDRESS *(If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)*

Division of License Renewal
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Same as above

10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

This document is a safety evaluation report (SER) on the license renewal application (LRA) for Three Mile Island Nuclear Station, Unit 1, (TMI-1) as filed by Amergen Energy Company, LLC, (subsequently Exelon Generation Company, LLC) (or the applicant). By letter dated January 08, 2008, the applicant, submitted an application to the U. S. Nuclear Regulatory Commission (NRC) for renewal of the TMI-1 operating license for an additional 20 years. The NRC staff (the staff) prepared this report to summarize the results of its safety review of the LRA for complicance with Title 10 Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," of the Code of Federal Regulations (10CFRPart 54). In its January 08, 2008 submission letter, the applicant requested renewal of the operating license issued under Section 103 (Operating License No. DPR-50) of the Atomic Energy Act of 1954, as amended, for TMI-1 for a period of 20 years beyond the current expiration date of April 14, 2014. TMI-1 is located approximately 10 miles southeast of Harrisburg, Pennsylvania. The staff issued the operating license on April 19, 1974. The plant's nuclear steam supply system consists of a pressurized water reactor with a lowered loop. TMI-1 operates at a licensed power output of 2,568 megawatt-thermal, with a gross electrical output of approximately 852 megawatt-electric. The updated final safety analysis report (UFSAR) shows details of the plant and the site. This SER summarizes the results of the staff's safety review of the LRA and describes the technical details considered in evaluating the safety aspects of the units proposed operation for an additional 20 years beyond the term of the current operating license.

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