3.1.4.1.2 Aging Management Programs

In Table 3.1-1 of the LRA, the applicant identifies the following AMPs applicable to the McGuire and Catawba RV internals:

- Chemistry Control Program
- ISI Plan
- Alloy 600 Aging Management Review
- Reactor Vessel Internals Inspection Program

The applicant concluded that these AMPs will manage the effects of aging, such that the intended function of the RV internals will be maintained consistent with the CLB under all design loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3). Table 3.1-1 narrows in scope which of these programs will be used to manage the aging effects identified in the table as being applicable to the specific RV internal components requiring AMRs.

The applicant did not specifically identify any TLAA in Section 3.1.1 of the LRA that is applicable to RV internals. However, Section 4.3 of the LRA includes a TLAA for metal fatigue of ASME Class 1 components that applies to RV internals.

3.1.4.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section 3.1.1 (including Table 3.1-1), and pertinent sections of LRA Appendices A and B, regarding the applicant's demonstration that the effects of aging will be adequately managed, so that the intended function(s) of the RV internals will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

In Table 3.1-1 of the LRA, the applicant states that the intended functions of the RV internals are to provide support and orientation of the reactor core (i.e., the fuel assemblies); provide support, orientation, guidance, and protection of the control rod assemblies; provide a passageway for the distribution of the reactor coolant flow to the reactor core; provide a passageway for support, guidance, and protection for the incore instrumentation; provide secondary core support for limiting the downward displacement of the core support structure in the event of a postulated failure of the core barrel; and provide neutron shielding of the reactor vessel and provide support for vessel material test specimens.

3.1.4.2.1 Aging Effects

In accordance with Section 3.1 of the LRA, the applicant has performed a review of industry experience and NRC generic communications relative to the RV internals components to provide reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for Catawba and McGuire. This also included the plant-specific operating experience at both subject plants.

LRA Table 3.1-1 lists the RV internals, intended functions, materials of construction, operating environment, aging effects, and aging management programs and activities credited to manage the identified aging effects for each RV internal component category. A review of the information in this table indicates that all applicable RV internals are identified, except for the BMI instrumentation tubes. The applicant has grouped the BMI instrumentation tubes with the RV and CRDM pressure boundary components.

The materials of construction for the RV internals are stainless steel, including CASS, and nickel-based alloy. All surfaces of RV internals are exposed to borated water. Table 3.1-1 of the LRA identifies that the following aging effects require aging management:

- cracking of stainless steel (including CASS) and nickel-based alloy components in a borated water environment
- loss of material from stainless steel (including CASS) and nickel-based alloy components in a borated water environment
- reduction in fracture toughness of stainless steel and cast austenitic stainless steel in a borated water environment
- loss of preload of stainless steel bolting and hold down springs in a borated water environment
- dimensional changes of stainless steel components in a borated water environment due to void swelling

As described in topical report WCAP-14577, Rev. 1-A, "License Renewal Evaluation: Aging Management for Reactor Internals," and the associated staff FSER, the aging mechanisms potentially applicable to the RV internals are neutron irradiation embrittlement, stress corrosion cracking (SCC), irradiation-assisted stress corrosion cracking (IASCC), erosion and corrosion processes, creep/irradiation creep, stress relaxation, wear, thermal aging, fatigue, and void swelling. However, the RV internals at McGuire and Catawba are made from materials that are resistant to loss of material by general corrosion and flow-assisted corrosion (erosion/corrosion). The RV internals for the McGuire and Catawba units also are not exposed to a high enough temperature (>540 °C or 1000 °F) where creep-induced degradation would become an aging concern for the internals.

Cracking of RV internals due to either SCC or IASCC is an applicable aging effect for RV internals. SCC results from the synergistic effects of tensile stresses and a corrosive environment on a susceptible material. SCC is a particular concern for bolting, given the potential for occluded environmental conditions in crevice areas. IASCC is SCC that is enhanced by exposure of the materials to ionizing radiation. Cracking of the RV internals may also occur from thermal fatigue. The applicant addresses thermal fatigue of the RV internals in Section 4.3 of the LRA, and the staff's evaluation of thermal fatigue of the RV internals is documented in Section 4.3 of this SER. In LRA Table 3.1-1, the applicant has identified cracking as an applicable aging effect for all RV internals. This is acceptable to the staff because the applicant has accounted for cracking of the RV internals that could be induced by either SCC, IASCC, or thermal fatigue.

Loss of material from wear of RV internals occurs due to relative motion between the interfaces and mating surfaces of components caused by flow-induced vibration during plant operation; differential thermal expansion and contraction movements during plant heatup and cooldown; and changes in power operating cycles. The severity of the wear depends on the frequency of motion, duration, and component loadings. Although the applicant did not discuss wear in LRA Section 3.1, the applicant did identify loss of material as an applicable aging effect for all RV internals in Table 3.1-1 of the application. This is acceptable to the staff because it agrees with

NUREG-1800 that loss of material is an applicable effect for the RV internals of PWRs, and because it specifically accounts for loss of material that could be induced by wear.

Stress relaxation may be defined as the unloading of preloaded components under conditions of long-term exposure of RV internals materials to high constant strain, elevated temperature, and/or neutron irradiation. Loss of preload due to stress relaxation is an applicable aging effect for those RV internals with substantial preload (e.g., hold down spring, bolted connections). A loss of preload in these components could result in higher cyclic and transient loads and a loss of function. The combination of bolt stress relaxation, changes in transient and high-cycle vibration of the RV internals, and the effects of increased RV internals fatigue susceptibility may be significant for the license renewal period. The RV internals susceptible to loss of preload due to stress relaxation are the upper and lower support column bolts, the hold down spring, and the clevis insert bolts. In LRA Table 3.1-1, the applicant has identified loss of preload as an applicable aging effect for the upper and lower support column bolts and the hold down spring, but not for the clevis insert fasteners.

By letter dated January 30, 2002, the staff informed the applicant that WCAP-14577, "License Renewal Evaluation: Aging Management for Reactor Internals," specifically identifies that loss of preload is an applicable effect for the clevis insert bolts (fasteners) during normal operations and requested (in RAI 3.1.4-4) the applicant to address this information from the WCAP. In its response to RAI 3.1.4-4, dated April 15, 2002, the applicant stated that loss of preload could be an applicable effect for the McGuire and Catawba clevis insert fasteners, and that the effects of loss of preload in the clevis insert fasteners would manifest itself as loose, cracked, or missing clevis inserts bolts (fasteners). The applicant stated that, since a VT-3 examination may not be sufficient to detect cracking, it will perform a VT-1 examination of the clevis insert fasteners each inspection interval. In the response to RAI 3.1.4-4, the applicant provided a supplemental AMR Table for the clevis insert fasteners that adds loss of preload as an applicable effect for the clevis insert fasteners (in addition to cracking and loss of material). The staff's evaluation of the applicant's proposed augmented inspection activities for the clevis insert fasteners is given in Section 3.1.4.2.2 of this SER.

The applicant's response to RAI 3.1.4-4, and supplemental AMR for the clevis insert fasteners, identifies that loss of preload is an additional aging effect for the RV internals upper and lower support column bolts, hold down spring, and clevis insert fasteners. This is acceptable to the staff because it accounts for stress relaxation, which is a contributing cause of loss of preload in these components, and because it agrees with Table 3.1-1 of NUREG-1800 in that loss of preload is an applicable aging effect for bolted, fastened, or spring loaded RV internals in PWR-designed reactors.

In LRA Section 3.1.1, the applicant states that reduction in fracture toughness due to thermal embrittlement can be an aging effect for certain types of CASS components in locations where temperatures continuously exceed 250 °C (482 °F). The staff, in a letter dated May 19, 2000, clarified that not all CASS materials are subject to thermal embrittlement and provided certain criteria for identifying CASS components susceptible to thermal embrittlement. In this letter, the staff specifically identified that centrifugally cast CASS materials are not subject to thermal aging in the same manner as are statically cast CASS materials. Neutron irradiation of CASS materials may also contribute to a loss of fracture toughness in the materials, if the exposure to the neutrons is above a certain threshold. The applicant stated that it performed an analysis of all CASS material components in the RCS. As a result of this analysis, the applicant identified that reduction in fracture toughness is an applicable aging effect for all RV internals made out of CASS. This is acceptable to the staff because it accounts for the effect of ionizing irradiation of the fracture toughness properties of CASS RV internals, and because it agrees with Table 3.1-1 of NUREG-1800 in that loss of fracture toughness is an applicable aging effect for all PWR RV internals made from CASS.

The RCCA guide tube support pins used in Westinghouse RV internals have a history of degradation. Several Westinghouse plants experienced cracking of guide tube support pins manufactured from Alloy X-750. The cracking of the Alloy X-750 material was attributed to the combination of high stress and undesirable microstructure. In WCAP-14577, Rev. 1-A, Westinghouse stated that cracking of the support pins will not result in a significant misalignment, and the intended function will be maintained. However, these pins are being replaced at a number of plants. Replacement is considered to be a sound maintenance practice to preclude degradation when industry experience indicates that such degradation has been observed. In Table 3.1-1 of the LRA, the applicant does not list the RCCA guide tube support pins as a separate entry. By letter dated January 28, 2002, the staff requested, in RAI 3.1.4-1, clarification of the aging management for these components at McGuire and Catawba. In its response dated April 15, 2002, the applicant indicated that the guide tube support pins, "split pins," are part of the guide tube assemblies in Table 3.1-1 (page 3.1-16, row 3) of the LRA. The applicant has stated that since the guide tube support pins (split pins) are fabricated from Type 316 cold worked stainless steel, they have the same aging effects applicable to the other stainless steel components in the guide tube assemblies. This is acceptable to the staff because it agrees with Table 3.1-1 of NUREG-1800 in that loss of material and cracking are both applicable effects for these components.

In LRA Table 3.1-1, the applicant did not identify reduction in fracture toughness due to irradiation as one of the applicable aging effects for the lower support plate (forging) and lower core support column reactor vessel internals. These materials are fabricated from austenitic stainless steel. In NUREG/CR-6048, Oakridge National Laboratory, on behalf of the NRC, has used 5×10^{20} neutrons/cm^2 (E > 1 MeV) as the threshold for loss of fracture toughness due to radiation embrittlement in Type 304 austenitic stainless steel materials. To substantiate that loss of fracture toughness is not an applicable effect for these components, the staff issued RAI 3.1.4-2, by letter dated January 28, 2002, and requested that the applicant confirm that accumulated neutron fluence (E > 1 MeV) for these components, during the period of extended operation, would be lower than this threshold for radiation-induced embrittlement. In the RAI, the staff also indicated that, if the fluence levels for the lower support plate (forging) and lower core support columns were projected to be greater than 5×10^{20} neutrons/cm^2 (E > 1 MeV), the applicant should discuss how reduction in fracture toughness in these components would be managed during the proposed extended periods of operation.

In its response to RAI 3.1.4-2, dated April 15, 2002, the applicant stated that the maximum projected fluence for the lower support forging at 54 ESPY is approximately 5×10^{18} neutrons/cm^2 (E > 1 MeV), which is less than the threshold fluence value established by the staff. The applicant stated that the lower support forging is not expected to experience reduction of fracture toughness as a result of neutron embrittlement. In contrast, the applicant also stated that the maximum projected fluence at the very top of the lower core support columns, the area of the columns closest to the core and subject to the highest neutron fluence, is approximately 5×10^{21} neutrons/cm^2 (E > 1 MeV), and that, because the projected fluence at the top portion of the support columns is projected to exceed the threshold 5×10^{20} neutrons/cm^2

(E > 1 MeV), reduction in fracture toughness should be included as an aging effect for the lower core support columns. The applicant also stated that this aging effect will be managed by the RV Internals Inspection Program (Section B.3.27 of LRA Appendix B). On the basis of this evaluation and in response to RAI 3.1.4-2, the applicant provided a supplemental AMR for the lower core support columns that added reduction of fracture toughness as an applicable aging effect for the lower core support columns. This is acceptable to the staff because it is in agreement with Table 3.1-1 of NUREG-1800 in that loss of fracture toughness due to neutron irradiation is an applicable effect for RV internals within the fuel zone region of the reactor (i.e., within regions of the reactor that amass high neutron fluence dose rates).

Void swelling is defined as a gradual increase in dimensions of the RV internals. Under reactor internals irradiation conditions, helium is generated as a nuclear transmutation reaction product. At sufficiently high temperatures, helium bubbles expand to a critical diameter and coalesce (unite) into larger bubbles. These bubbles create void areas (gaps) in the materials and may result in the swelling of the material. Swelling changes the dimensions of the material and may affect the ability of the particular RV internal component to perform its intended functions. Although void swelling has not been observed to date, the staff is concerned that void swelling may become significant during the period of extended operation. Until industry has developed sufficient data to demonstrate that void swelling is not a significant aging mechanism, the staff believes that void swelling should be considered significant, and applicants for license renewal should describe their aging management plan to address void swelling. In LRA Table 3.1-1, the applicant has identified change in dimension as an applicable aging effect for some of the RV internals, presumably those exposed to the highest neutron fluence. By letter dated January 28, 2002, the staff requested, in RAI 3.1.4-3, additional information concerning the criteria applied to establish which RV internals are susceptible to change in dimension due to void swelling.

In its response to RAI 3.1.4-3, dated April 15, 2002, the applicant stated that uncertainty currently exists relative to the prediction of void swelling in PWR conditions. This uncertainty is based on the fact that existing swelling data have been obtained from materials that were not irradiated in a PWR environment. Void swelling is a complex function of neutron flux, neutron fluence, operating temperature, operating stress, material composition, and material fabrication process. However, the key environmental factors influencing void swelling are cumulative radiation dose and temperature.

At present, data are not available to ascertain a specific threshold for the onset of void swelling in solution annealed Type 304 stainless steel in a PWR environment. However, the onset of void swelling in solution annealed and 10, 20, 30 percent cold worked Type 304 stainless steel exposed to a breeder reactor environment is available and is estimated to start at fluence levels of approximately 4 to 8 x 10^{22} neutrons/cm^2 (E > 1 MeV) at a temperature of 440 °C (824 °F). (Effects of Radiation on Materials, ASTM STP725, Comparison of High-Fluence Swelling Behavior of Austenitic Stainless Steels, Page 484.) PWRs operate at approximately 315 °C (599 °F) well below 440 °C (824 °F). Duke conservatively estimated all reactor vessel internal components that receive greater than 10^{22} neutrons/cm^2 (E >1 MeV) as having the potential for void swelling as an aging effect.

At the time this LRA was being prepared, the reactor vessel internals locations identified in Table 3.1-1 as susceptible to dimensional changes were considered to be the limiting locations. However, based on a fluence analysis that has been recently completed, several of these locations are no longer considered to be limiting. The locations that are no longer considered to be limiting are the core barrel flange, outlet nozzles, neutron panels, and irradiation and specimen holder fasteners. These locations do not fall within the range of fluence identified above and should not have dimensional change due to void swelling as an aging effect during the license renewal period.

Understanding the factors discussed above requires further assessment of the operating conditions experienced in PWRs and how stainless steel responds under these conditions. Duke is currently participating in industry programs, which are addressing the significance of void swelling. These programs are addressing both the physical phenomenon of void swelling, as well as the safety significance. As understanding of the phenomenon of void swelling increases, Duke will adjust programmatic management of the RV internals, as needed, to ensure that there remains reasonable assurance that there is not a loss of intended function during the period of extended operation due to void swelling. The RV internals inspection (Section B.3.27 of LRA Appendix B) identifies the applicant's committed actions with respect to identification and inspection of the RV internals most susceptible (limiting) to void swelling, including participation in the industry's programs to address this issue. The staff's evaluation of this AMP is documented in Section 3.1.4.2.2 of this SER.

Westinghouse WCAP-14577, Rev. 1-A, "License Renewal Evaluation: Aging Management for Reactor Internals," defines fatigue as the structural deterioration that results from repeated stress/strain cycles due to fluctuating loads and temperatures. Following repeated cyclic loading of sufficient magnitude, damage can accumulate, initiating a crack in highly affected locations. As described in the topical report, the design bases for many Westinghouse RV internals include explicit fatigue evaluations. This is the case not only for RV internals designed to the ASME Boiler and Pressure Vessel Code, Section III, Subsection NG, 1974 Edition, but also for RV internals designed using the ASME Code as a guide, prior to incorporation of Subsection NG in the code. The McGuire and Catawba RV internals were designed before the incorporation of Subsection NG in the 1974 ASME Code. LRA Section 4.3 describes the applicant's TLAA for metal fatigue. The staff's evaluation of the TLAA for metal fatigue is given in Section 4.3 of this SER.

On the basis of the description of the internal and external environments, materials used, and the applicant's review of industry and plant-specific experience, the staff concludes that the applicant has identified all aging effects that are applicable for the RV internals.

3.1.4.2.2 Aging Management Programs

In Table 3.1-1 of the LRA, the applicant credits the following AMPs to manage aging of the RV internals:

- Chemistry Control Program
- ISI Plan
- Alloy 600 Aging Management Review
- Reactor Vessel Internals Inspection Program

In Table 3.1-1 of the LRA, the applicant lists all RV internals components within the scope of the license renewal with their intended functions, material groups, and environment. Also, the table identifies the aging effects requiring management, and the plant-specific AMPs required to manage the aging effects, during the period of extended operation.

The Chemistry Control Program (Section B.3.6 of LRA Appendix B) provides water quality that is compatible with the materials of construction used in McGuire and Catawba RV internal components in order to minimize loss of material and cracking. This program is developed based on plant technical specification requirements and on EPRI guidelines, which reflect industry experience. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for RV internals. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

The ISI plan (Section B.3.20 of LRA Appendix B) manages aging effects of loss of material, cracking, gross loss of preload, and gross reduction in fracture toughness. The scope of the ISI plan for Class 1 components complies with the requirements of ASME Section XI, Subsection IWB. Depending on the examination category, the methods of inspections may include visual, surface, and/or volumetric examination of weld locations susceptible to aging degradation. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for the reactor vessel internals. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

In its response to RAI 3.1.4-4, the applicant identified that loss of preload was an applicable aging effect for the RV internals clevis insert fasteners, and stated that the ISI plan will be augmented to manage loss of preload in the RV internals clevis insert fasteners. Therefore, the applicant stated that the following will be added to both Section 18.2.16 of the FSAR supplement for the McGuire station and Section 18.2.15 of the FSAR supplement for the Catawba station: "A VT-1 examination of the reactor vessel internal clevis insert fasteners will be performed in lieu of the VT-3 examination currently required by ASME Section XI."

This statement supplements the monitoring and trending program attribute for the ISI plan (Section B.3.20 of Appendix B to the LRA). The staff concludes that the proposal to use a VT-1 examination, in lieu of a VT-3 examination of the clevis insert fasteners once an ISI interval, is acceptable because the requirements imposed by ASME Section XI for performing VT-1 type visual examinations are more conservative than those imposed by ASME Section XI for performing VT-3 type visual examinations. The applicant's method for inspecting the clevis insert fasteners during the extended periods of operation is therefore acceptable to the staff.

As it relates to RV internals, the purpose of the Alloy 600 Aging Management Review, as described in Section B.3.1 of LRA Appendix B, is to ensure that nickel-based alloy locations are adequately inspected for cracking due to PWSCC by the ISI plan and the reactor vessel internals inspection. This review will be completed after issuance of a renewed operating license, but before June 12, 2021, for McGuire, and before December 6, 2024, for Catawba. The staff has evaluated this AMP and found it to be acceptable for managing the aging effects identified for RV internals. The staff's evaluation of the Alloy 600 aging management review is documented in Section 3.1.2.2.2 of this SER.

The Reactor Vessel Internals Inspection, as described in Section B.3.27 of LRA Appendix B, manages cracking due to IASCC and SCC, reduction in fracture toughness due to irradiation and thermal embrittlement, dimensional changes due to void swelling, and loss of preload due to stress relaxation. The staff's evaluation of this program follows.

Reactor Vessel (RV) Internals Inspection

The applicant describes the Reactor Vessel (RV) Internals Inspection program in Section B.3.27 of LRA Appendix B. The applicant credits this AMP to manage specific RV internals aging effects for McGuire and Catawba. The staff reviewed the applicant's description of the program to determine whether the applicant had demonstrated that it will adequately manage the applicable effects of aging in applicable RV internals during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The purpose of the RV Internals Inspection program is to monitor the condition of RV internals in order to assure that the applicable aging effects will not result in loss of their intended functions during the period of extended operation. The applicant identifies three groups of stainless steel RV internals within the scope of this AMP: (1) plates, forgings, and welds, (2) baffle-to-baffle, baffle-to-former, and barrel-to-former bolting, and (3) items fabricated from CASS. The applicant stated that different aging effects will affect various RV internal parts. The aging effects addressed by this AMP are: (1) cracking, (2) loss of preload, (3) reduction in fracture toughness, and (4) dimensional changes. The applicant stated that this AMP will supplement the ISI plan to assure that aging effects potentially requiring additional management will not result in loss of intended functions of the RV internals during the period of extended operation.

Table 3.1-1 of the LRA identifies that the RV internals that will be managed by AMP B.3.27 are CASS upper support column (base, conduit support, thermocouple stop(U1)); upper support column bolts; upper core plate and its alignment pins; fuel alignment pins; CASS 15x15 and 17x17 guide tube assembly; CASS UHI flow columns (base); core barrel, flange and outlet nozzles, neutron panels, irradiation specimen holder fasteners; baffle and former plates; baffle bolts; lower core plate, fuel alignment pins, lower support column bolts; and CASS BMI (upper end, cruciform).

The applicant credited the McGuire/Catawba RV Internals Inspection for managing aging effects in the McGuire/Catawba RV internal components. The staff evaluated the RV Internals Inspection on the following seven program attributes for the program:

1. program scope
2. preventive actions
3. parameters monitored or inspected
4. detection of aging effects
5. monitoring and trending
6. acceptance criteria
7. operating experience

The staff's evaluations of these program attributes are given in the paragraphs that follow. The staff's evaluation of the other three program attributes (confirmatory actions, corrective actions, and administrative controls) for the RV Internals Inspection is documented in Section 3.0.4 of this SER.

[Program Scope] The applicant stated that the scope of this AMP consists of three groups of stainless steel RV internals: (1) items comprised of plates, forgings, and welds, (2) bolting (baffle-to-baffle, baffle-to-former, and barrel-to-former), and (3) items fabricated from CASS. Note that the applicant has proposed to use an augmented ISI plan VT-1 examination as the method for managing loss of preload in the clevis insert fasteners in lieu of the RV internals inspection. The staff's evaluation of the augmented ISI examination method for managing loss of preload in the clevis insert fasteners is given in Section 3.1.4.2.2 of this SER. The staff concludes that the applicant's scope for the RV Internals Inspection program identifies the appropriate RV internal components that need aging management by the program.

[Preventive Actions] The applicant stated that there are no preventive/mitigative actions associated with this program, nor did the staff identify a need for such. The RV Internals Inspection program is a surveillance monitoring program and, as such, is not designed to prevent or mitigate the aging effects for the RV internal components prior to their occurrence. Since the RV internals inspection is not a preventive or mitigative aging management program, the staff concludes that the preventive actions program attribute for the RV Internals Inspection is acceptable.

[Parameters Monitored or Inspected] The program requires the applicant to perform visual inspections of the RV internals components for the purpose of detecting loss of material due to wear or cracking initiated by fatigue, SCC or IASCC. Visual inspections will also be performed to detect dimensional changes induced by void swelling. Volumetric inspection of bolting is performed to detect IASCC. The RV Internals Inspection requires the applicant to inspect CASS or highly irradiated stainless steel RV internals components for cracks to ensure that the components will not fail catastrophically as a result of fast fracture. The staff concludes that the [Parameters Monitored or Inspected] attribute for the RV Internals Inspection is acceptable because the program directly monitors for flaws (cracking and loss of material) that may occur in the RV internal components and because the program indirectly monitors for materials and mechanical property changes (i.e., for materials/mechanical property-related aging effects of loss of fracture toughness, void swelling, and loss of preload) that may occur in the internals. In the case of the later, the program accomplishes this by ensuring the cracks are detected prior to growth above a limiting size, by monitoring for dimensional changes in RV internal components, and by monitoring for loose or displaced RV internal components, respectively.

[Detection of Aging Effects] The applicant stated that the RV Internals Inspection program uses visual and volumetric inspection methods to monitor for flaws (cracking and loss of material) in the RV internal components. The program also indirectly monitors for materials and mechanical property changes (i.e., for materials/mechanical property-related aging effects of loss of fracture toughness, void swelling, and loss of preload) by ensuring the cracks are detected prior to growth above a limiting size, by monitoring for dimensional changes in RV internal components, and by monitoring for loose or displaced RV internal components. In accordance with the ISI plan, ISI Examination Category B-N-3, for removable core support structures, is directly applicable to the RV internals. This requires visual VT-3 examination of all accessible parts of the RV internals. Cracks initiated by stress corrosion cracking or fatigue will start off very small and will grow over time. VT-3 visual examinations may not be adequate for detecting cracks before they reach the critical flaw size. The monitoring and trending section of this program, which describes the inspection activities for various types of RV internals, indicates that a visual inspection will be performed on components fabricated from plates, forgings and welds to detect the effects of cracking. By letter dated January 30, 2002, the staff requested, in RAI B.3.27-2, the applicant to indicate which visual inspection method (VT-1, VT-2 or VT-3) will be used so that the staff can determine if the visual inspection activities will be capable of detecting cracks before a critical flaw size is reached, and that if VT-3 is proposed as the inspection method, to justify the use of this method for identifying small cracks, or describe enhancements planned to augment this inspection activity.

In its response to RAI B.3.27-2 dated April 15, 2002, the applicant stated that the reactor vessel internals inspection is a program that is completely separate from the ISI Plan. As described in Section B.3.27 of the LRA, the RV internals inspection is being developed to supplement the ISI Plan and is separate from the VT-3 visual examinations currently required by examination category B-N-3. The applicant also stated that the RV Internals Inspection includes several inspections and examinations. The applicant stated that items comprised of plates, forgings, and welds that will be visually inspected, the critical crack size will be determined by analysis and the acceptance criteria for all aging effects will be developed prior to the inspection. The applicant stated that the visual inspection method will be sufficient to detect the critical crack size determined by analysis.

For inspections of baffle bolts, the applicant stated it will perform volumetric examinations to detect whether cracking has occurred in the bolts. As discussed in the staff's FSER for Westinghouse WCAP-14577, Rev. 1-A, "License Renewal Evaluation: Aging Management for Reactor Internals," visual examinations will not detect cracking in these bolts. Industry experience is that the cracks will form under the head of the bolts, which is not accessible for visual examination. In addition, loose parts monitoring and coolant reactivity monitoring are effective only after the aging effects have manifested themselves in a potentially serious way. Therefore, augmented inspections, such as ultrasonic examinations, are proposed to provide effective aging management. This is acceptable since the method will be capable of detecting cracks under the heads of the bolts that would not necessarily be detected by use of visual examination methods.

Neutron embrittlement and thermal aging are two mechanisms that may reduce the fracture toughness for a given material. Reduction in fracture toughness lowers the material's critical crack size, which is a bounding material property for any given material. When cracks exist in a component and grow to sizes larger than the critical crack size for the component's material of fabrication, the cracks are considered to be unstable and will propagate quickly through the component. This phenomenon is referred to by materials and mechanical engineers as crack growth by fast fracture. Cracks that propagate unstably by this phenomenon may lead to catastrophic failure of the component. CASS components are known to be particularly susceptible to reduction in fracture toughness as a result of thermal aging; neutron embrittlement of CASS internals may enhance this effect. When this occurs, a CASS component's tolerance to withstand the presence of existing flaws (cracks) is significantly reduced. Thus, while the RV Internals Inspection will not be capable of detecting the critical crack size for the RV internal components made from CASS materials (i.e., because the critical crack size is a material property, not an actual crack or flaw in the material), the examination is designed to detect potential cracks in the RV internals prior to their growing to a size greater than the critical crack size for the material (i.e., critical crack size as reduced as a result of loss of fracture toughness in the material). The applicant has stated that the critical crack size for the CASS RV internals will be established by engineering analysis or calculation, which is the typical method of determining the critical crack size for a given material. Given the applicant's response to RAI B.3.27-2, the applicant must select an examination method that can actually characterize the sizes of potential cracks in the CASS RV internals, and must perform the examination prior to entering the periods of extended operation. When assessed from these technical bases, the applicant's Parameters Monitored or Inspected program attribute is acceptable to the staff.

In electronic correspondence dated June 5-6, 2002 (ADAMS Accession No. ML022200661), the staff asked the applicant to clarify the last sentence of the second paragraph of its response to RAI B.3.27-2. This clarification would be reflected in the Detection of Aging Effects program attribute for this program that is provided in FSAR supplement Chapter, Section 18.2.22. The applicant agreed to make this clarification. By letter dated July 9, 2002, the applicant provided the following:

> Duke confirms that the intent of the last sentence in the second paragraph of its response should be clarified to state:
>
> > The visual inspection method selected for the inspection of RV internal plates, forging, and welds will be sufficient to detect cracks in the components prior to any growth to a size that is greater than the critical crack size (critical crack length) for the material.

Therefore, this issue is resolved.

[Monitoring and Trending] The applicant stated that the RV Internals Inspection includes the following inspection activities: (1) for plates, forgings, and welds, a visual inspection will be performed to detect the effects of cracking by irradiation-assisted stress corrosion cracking enhanced by reduction of fracture toughness by irradiation embrittlement, (2) for baffle bolts, a volumetric inspection will be performed at McGuire 1 to assess cracking, and (3) for items fabricated from CASS, an analytical approach to assess the effect of reduction of fracture toughness on the applicable reactor vessel internals items will be performed. The applicant stated that the specific inspection method will depend on the results of these analyses. The applicant stated that the inspections of RV internals at McGuire 1 will be performed in the fifth ISI interval. The decision to perform inspections on McGuire 2, Catawba 1, and Catawba 2, and when to perform such inspections, will depend on an evaluation of the results of the internals inspections performed at Oconee and on McGuire 1.

The applicant also stated that, with respect to dimensional changes due to void swelling, McGuire and Catawba will rely on the results of inspections to be performed at Oconee, and that items comprised of plates, forgings, and welds will be inspected at all three Oconee units to assess the effects of void swelling. Activities are in progress to develop and qualify the inspection method. The applicant stated the results of the Oconee inspections will be used to determine if change in dimensions due to void swelling is a concern for the reactor vessel internals of McGuire 1, McGuire 2, Catawba 1, and Catawba 2, and if additional inspections are necessary. In addition, the applicant stated that should industry data or other evaluations indicate that any of the above inspections can be modified or eliminated, Duke will provide plant-specific justification to demonstrate the basis for the modification or elimination. With regard to monitoring for dimensional changes to due void swelling, this is acceptable to the staff because the Oconee, McGuire, and Catawba plants all have RV internals that are made from martensitic stainless steel materials, austenitic stainless steel materials (including CASS), and nickel-based alloy materials.

By letter dated January 28, 2002, the staff requested, in RAI B.3.27-1, the applicant to clarify the technical validity of this extrapolation, specifically with respect to the similarities and differences pertaining to RV internals design details, materials of construction, reactor power rating and neutron fluence levels, and critical locations where dimensional changes may compromise performance of intended functions. In its response dated April 15, 2002, the applicant stated that currently, limited data from PWR internals are available to properly evaluate the potential for dimensional changes to occur as a result of void swelling. Additional data are needed to properly evaluate the most susceptible locations for inspections. The applicant stated that the Oconee RV Internals Inspections will provide some of that data prior to the McGuire and Catawba license renewal period. Current plans are to inspect the Oconee Unit 1 internals for dimensional changes due to void swelling early in its 20-year period of extended operation or about 2015. Based on the Oconee inspections, as well as results from other internals inspections in the industry, the applicant stated that it will prepare the inspection plan for McGuire 1.

In the Monitoring and Trending attribute for the RV Internals Inspection AMP, the applicant stated that it will perform a volumetric inspection of the McGuire 1 baffle bolts in the fifth ISI interval, and that any detectable cracks are considered to be unacceptable. The applicant also stated that the number of baffle bolts to be inspected and their locations will be determined by analysis. As discussed in the staff's FSER for Westinghouse WCAP-14577, Rev. 1-A, "License Renewal Evaluation: Aging Management for Reactor Internals," visual examinations will not detect cracking in these bolts. Industry experience is that the cracks will form under the head of the bolts, which is not accessible for visual examination. In addition, loose parts monitoring and coolant reactivity monitoring are effective only after the aging effects have manifested themselves is a potentially serious way. Therefore, augmented inspections, such as ultrasonic inspections, are needed to be proposed in order to provide effective aging management of the baffle bolts

In RAI 3.27-1, the staff questioned the validity that the results of the baffle bolt examinations at McGuire 1, as well as Oconee Unit 1, would provide an acceptable basis for determining whether to schedule and perform corresponding baffle bolt examinations at McGuire 2 and Catawba 1 and 2. In its response to RAI B.3.27-1, the applicant also provided the following tabular comparison of the reactor power level, materials, operating temperatures, and estimated peak fluence for the Oconee Unit 1, McGuire 1 and 2, and Catawba 1 and 2 baffle plate and bolt locations at the end of 40-year current licensing period:

Unit	Reactor Power (MWt)	Baffle Former and Plate Material	Baffle Bolt Material	T_{Hot}	T_{Cold}	Estimated Peak Fluence at Baffle Plate and Bolt location (n/cm^2, E>1MeV) and year
ONS 1	2568	Type 304 Stainless Steel	Type 304 Stainless Steel	602.4	557.8	$4.5x10^{22}$ in 2015*
MNS 1	3411	Type 304 Stainless Steel	Type 316 Cold Worked	613.9	556.3	$5.95x10^{22}$ in 2021**
MNS 2	3411	Type 304 Stainless Steel	Type 316 Cold Worked	613.9	556.3	$5.8x10^{22}$ in 2024**
CNS1	3411	Type 304 Stainless Steel	Type 316 Cold Worked	613.9	556.3	$5.7x10^{22}$ in 2025**
CNS2	3411	Type 304 Stainless Steel	Type 316 Cold Worked	616.7	558.3	$5.8x10^{22}$ in 2026**

* Estimated fluence at the time of the first reactor vessel internals inspection at Oconee
** End of 40-year operating license for each unit

On the basis of this comparison, the applicant believes that the estimated peak neutron fluence levels for the McGuire and Catawba baffle bolts at the end of the 40-year operating terms for the units will be similar to the estimated peak neutron fluence levels for the Oconee Unit 1 baffle bolts at the time the Oconee Unit 1 baffle bolts are planned to be inspected (in 2015).

The McGuire, Catawba, and Oconee baffle bolts are all fabricated from austenitic stainless steel materials (Type 304 and Type 316 are both austenitic stainless steel grades of materials) that have similar material properties. Since the McGuire, Catawba, and Oconee baffle bolts are all fabricated from austenitic stainless steel materials, and since the amassed end-of-current-operating-term neutron fluences values for the McGuire and Catawba baffle bolts are expected to be of an order and magnitude similar to that amassed for the Oconee Unit 1 baffle bolts at the time the Oconee Unit 1 baffle bolts will be inspected, the staff concludes that the volumetric examination results of the Oconee Unit 1 and McGuire 1 baffle bolts will be a prime indicator of the condition in the McGuire and Catawba baffle bolts, and thus justifying use of these examinations as the basis for proposing whether examinations of the baffle bolts at McGuire 2 and Catawba 1 and 2 are necessary during the extended periods of operation for the units. Based on these technical considerations, the staff concludes that the applicant has proposed an acceptable basis for scheduling and performing volumetric examinations of the McGuire and Catawba baffle plates, and that the Monitoring and Trending attribute, as it pertains to inspections of the McGuire and Catawba baffle bolts, is therefore acceptable.

For the McGuire and Catawba RV internals made from CASS (i.e., 15X15 and 17X17 guide tube assemblies, BMI tubes, and bases of the UHI flow columns), Duke proposes to use an analytical evaluation as the basis for inspecting these components for cracks. The purpose of the analytical evaluation is to calculate the critical crack size for the components under service loading conditions and service-degraded material properties (i.e., loss of fracture toughness), and to determine the type of NDE needed to detect cracks in the components prior to fast fracture to failure. The applicant proposes to inspect the limiting CASS component at McGuire 1 in the fifth ISI Interval for the plant, and to use the results of the examinations as the basis for proposing whether corresponding examinations are warranted of the CASS RV internals at McGuire 1 and Catawba 1 and 2. The applicant's program and basis for inspecting the CASS

RV internals at McGuire and Catawba is acceptable because the McGuire 1 reactor is expected to be the limiting reactor with respect to neutron exposure, and the results of the inspections of the CASS RV internal components at McGuire 1 will provide a prime indication of the condition these components and form an acceptable basis for determining whether equivalent inspections of the CASS RV internal components at McGuire 2 and Catawba 1 and 2 are necessary.

For the remaining RV internal plates, forgings, welds, and bolts (i.e., core barrel bolts and thermal shield bolts), the applicant has proposed to use examinations performed at Oconee Unit 1 and McGuire 1 as the basis for determining whether additional, corresponding examinations need to be scheduled and performed at McGuire 2 and both Catawba units. By letter dated June 26, 2002, the staff informed the applicant that its program for inspecting these RV internal plates, forgings, welds, and bolts was inconsistent with Duke Power Company's corresponding program for the Oconee Nuclear Station, in which the applicant had proposed to inspect these components in all three Oconee reactor units. In its response dated July 9, 2002, the applicant stated that the justification for using inspections of the McGuire 1 welded plates and forgings, welds, and bolts (i.e., core barrel bolts and thermal shield bolts) was based on a determination that McGuire 1 was the most susceptible unit with regard to aging of RV internals at McGuire and Catawba. The applicant also stated that the decision to use inspections at Oconee 1 as an additional basis for scheduling inspections of the RV internals at McGuire 2 and Catawba 1 and 2 was based on the fact that the RV internals would be inspected prior to the time that any of the McGuire and Catawba units would enter their respective periods of extended operation.

Aging of RV internal components is dependent on a number of factors, including amassed neutron irradiation dose, internal RV operating temperature, and stress and/or pressure loadings. Fabrication factors are also relevant for welded RV internals. The design fabricator of the RVs for McGuire 1 and Catawba 2 is not the same as the design fabricator for McGuire 2 and Catawba 1 or the design fabricator for the reactor units of the Oconee Nuclear Station. The McGuire 1 and Catawba 2 reactor vessels were designed, welded, and fabricated by the Combustion Engineering Corporation. The McGuire 2 and Catawba 1 reactor vessels were designed, welded, and fabricated by the Rotterdam Drydock. The reactor vessels for Oconee Units 1, 2, and 3 were designed, welded, and fabricated by the Babcock and Wilcox Corporation. For welded RV internal components, differences in welding techniques (including differences in the use of preheat methods or post-weld heat treatment methods, differences in welding fabrication methods, variations in the type of weld fluxes used, etc.) that are used to fabricate the vessels and their internal components can create a significant variation as to the susceptibility of the components to crack. The staff concluded that, since the fabricator of the McGuire 1 and Catawba 2 RVs is not the same as the fabricators of the McGuire 2 and Catawba 1 RVs or for the Oconee RVs, some uncertainty exists as to whether the inspections of welded RV internals at Oconee Unit 1 and McGuire 1 will be truly representative of the condition of welded RV internals at McGuire 2 and the Catawba units. The staff's position was that the applicant should schedule inspection of remaining RV internal plates, forgings, welds, and bolts (i.e., core barrel bolts and thermal shield bolts) at all of the McGuire and Catawba reactor units. Therefore, this issue was characterized as SER open item 3.1.4-1(a).

In its response to open item 3.1.4-1(a), dated October 28, 2002, the applicant clarified that all of the RV internals for the McGuire and Catawba units were manufactured by Westinghouse, not by the fabricators of the RVs (i.e., neither Combustion Engineering nor Rotterdam Drydock fabricated the RV internals). In its response, the applicant provided an acceptable design-feature-based argument for concluding that the baffle bolts and plates at McGuire were limiting in regard to the temperatures and fluences the materials would achieve when compared to those in the Catawba units. The applicant also stated that the Catawba RV baffle bolts and plates will have significantly lower potential to develop the aging effects attributed to RV internals (cracking, loss of fracture toughness due to either thermal aging or neutron irradiation embrittlement, or change in dimensions due to void swelling) because they include an original upflow design with cooling holes for the baffle bolts and pressure relief holes in the baffle plates, and because the stresses in the Catawba baffle plates are lower as a result of a lower differential pressure across the baffle plates from the bypass region. The applicant identified that the only significant weld in the McGuire and Catawba RV internals is the circumferential weld in the core barrel and stated that these circumferential welds are projected to have a neutron fluence at EOLE that is lower than the threshold for which irradiation-assisted stress corrosion cracking is to be of concern. The applicant stated that all other welds in the internals are used to capture locking devices. The applicant clarified that the core barrel bolts and thermal shields in the Oconee designs are not applicable to the designs of the RV internals at McGuire and Catawba.

Based on these arguments, the applicant concluded that the McGuire RV internals will be limiting (bounding) in comparison to the corresponding RV internal components at Catawba. Therefore, in its response to open item 3.1.4-1(a), the applicant committed to inspect the RV internals at both McGuire 1 and McGuire 2 during the periods of extended operation for the units, and to use the results of the examinations as the basis for determining whether additional inspections of the RV internals at Catawba 1 and Catawba 2 would be necessary. This commitment was documented in revised descriptions of the Monitoring and Trending program attribute in the FSAR supplements for McGuire and Catawba, which were included in the applicant's open item response. The applicant stated that the RV internals at McGuire 1 will be inspected during the fifth ISI interval for the unit, and the RV internals at McGuire 2 will be inspected during the sixth ISI interval for the unit. Based on this response, the applicant will be performing inspections of the RV internals at five of the seven Duke-owned nuclear reactors, (i.e., at Oconee and McGuire). Since the McGuire RV internals are projected to be limiting in comparison to those at Catawba, the staff concludes that the applicant's proposed inspections for the RV internal core barrel components at McGuire (and at Oconee) will provide an acceptable basis for determining whether age-related degradation is applicable in the corresponding components at Catawba, and for scheduling inspections at Catawba as necessary. This resolves open item 3.1.4-1(a).

[Acceptance Criteria] The applicant stated that the acceptance criteria will be based upon analyses and inspections. The applicant stated that the critical crack size for RV internal plates, forgings, welds, and RV internals made from CASS will be determined by analysis before inspection. For RV internal baffle bolts, any detectable cracking on baffle bolts will be unacceptable. The number of baffle bolts needed to be intact and their locations will be determined by analyses. The applicant did not provide any acceptance criteria for the dimensional change effects that could be induced by void swelling. The applicant's acceptance criteria for the RV Internals Inspection program is incomplete. Therefore, the staff needed additional information regarding the acceptance criteria for the inspections that are proposed to the RV internals. This issue was characterized as SER open item 3.1.4-1(b).

In its response to open item 3.1.4-1(b), dated October 28, 2002, the applicant stated that the Acceptance Criteria attribute of the RV Internals Inspection summary description contained in each station's FSAR supplement will be revised to read as follows (revised text underlined):

> For the items comprised of plates, forgings, and welds, critical crack size will be determined by analysis <u>and submitted for review and approval to the NRC staff</u> prior to the inspection.
>
> For baffle bolts, any detectable crack indication is unacceptable for a particular baffle bolt. The number of baffle bolts needed to be intact and their locations will be determined by analysis.
>
> For items fabricated from CASS, critical crack size will be determined by analysis. Acceptance criteria for all aging effects will be developed <u>and submitted for review and approval to the NRC staff</u> prior to the inspection.
>
> <u>For items subject to dimensional changes due to void swelling, activities are in progress to develop and qualify the inspection method. Acceptance criteria will be developed and submitted for review and approval to the NRC staff prior to the inspection.</u>

The applicant's FSAR supplement summary description for the acceptance criteria for the RV Internals Inspection addresses the need to submit the acceptance criteria established by industry programs for evaluating cracking, loss of fracture toughness, and void swelling in Westinghouse-designed RV internals to the staff for review and approval. This is acceptable to the staff since the industry is currently in the process of establishing what the techniques and acceptance criteria will be for evaluation of these aging effects in Westinghouse-designed RV internals. This resolves SER open item 3.1.4-1(b).

[Operating Experience] The applicant states that the RV Internals Inspection program is a new inspection, and no operating experience exists. The applicant has stated that the RV Internals Inspection proposed for McGuire 1 will be based upon implementation of a similar program for the Oconee Unit 1, and that the decision to examine the RV internals for McGuire 2 and the Catawba reactor units will be based on the combined RV Internals Inspection results for Oconee Unit 1 and McGuire 1. This is acceptable to the staff since there is no current industry experience that could assist the applicant in developing the other program attributes for the RV Internal Inspection.

FSAR Supplement: The staff reviewed LRA Appendix A.1, Section 18.2.22, for McGuire, and LRA Appendix A.2, Section 18.2.21, for Catawba. The staff requested that Duke provide a commitment to update the Detection of Aging Effects program attribute in FSAR supplement Section 18.2.22, "Reactor Vessel Internals Inspection," to reflect the second paragraph in the applicant's response to RAI B.27-2. For tracking purposes, the staff and applicant characterized this issue as SER open item 3.1.4-1(c).

In its response to open item 3.1.4-1(c), dated October 28, 2002, the applicant stated that the FSAR supplements for McGuire and Catawba will be revised to incorporate the following statement:

> The visual inspection method selected for the inspection of RV internal plates, forging, and welds will be sufficient to detect cracks in the components prior to any growth to a size that is greater than the critical crack size (critical crack length) for the material.

The applicant's response to open item 3.1.4-1(c) addresses the issue that, for visual inspections of RV internals at McGuire and Catawba, the applicant will have to implement a visual inspection technique that is capable of detecting surface cracks in the internal components, and is therefore acceptable. This resolves open item 3.1.4-1(c).

In conclusion, the staff reviewed the RV Internals Inspection program. With the resolution of SER open item 3.1.4-1(a), (b), and (c), the staff finds that the implementation of this AMP will provide reasonable assurance that the cracking, loss of preload, dimensional changes, and reduction in fracture toughness of RV internals will be adequately managed, such that the intended function(s) of the RV internals will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.4.3 Conclusions

The staff reviewed the information included in Section 3.1.1 of the LRA, as supplemented by the April 15, 2002, response to the RAI. With the resolution of SER open item 3.1.4-1(a), (b), and (c), the staff concludes that the applicant has demonstrated that the aging effects associated with the RV internals will be adequately managed, so that there is reasonable assurance that these components will perform their intended function(s) consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.5 Steam Generators

Each reactor unit at McGuire and Catawba has four recirculating steam generators (SGs), with one steam generator in each of the four reactor coolant loops. The original Westinghouse (W) models D2 and D3 SGs at Catawba 1, McGuire 1, and McGuire 2 had a number of internal components, including the SG tubes and the tube support plates, that experienced significant degradation during their first few years of service. As a result, Catawba 1, McGuire 1 and McGuire 2 replaced their original SGs with the enhanced model CFR-80 replacement steam generators (RSGs) manufactured by Babcock and Wilcox International (BWI) of Canada in 1996, 1997, and 1998, respectively. The Westinghouse Model D5 SGs at Catawba 2 have not been replaced since they already incorporated many of the enhanced design features of the BWI RSGs and have not experienced the types of degradation observed in Westinghouse D2 and D3 model SGs.

All steam generators at both sites are vertical shell and U-tube evaporators with integral moisture separating equipment. Reactor coolant flows through the inverted U-tubes, entering and leaving through nozzles equipped with stainless steel safe ends located in the hemispherical bottom head of the steam generator. Steam is generated on the shell side of the tubes, and the water-steam mixture flows upward through the tube bundle and into the steam drum section. Centrifugal moisture separators, located above the tube bundle, remove most of the entrained water from the steam. Steam dryers are employed to increase the steam quality before the steam flows upward to the outlet nozzle at the top of the steam generator.

While significant hardware differences exist between the Westinghouse model D5 SGs at Catawba 2 and the BWI model CFR-80 RSGs at Catawba 1, McGuire 1, and McGuire 2, the basic function is essentially identical with one exception in the feedwater delivery system. The Westinghouse model D5 SGs are equipped with preheaters and feedwater flow restrictors with main feedwater delivered just above the tubesheets. Feedwater in the BWI RSGs is distributed by a feedring header, flows directly into a downcomer section, and is mixed with saturated recirculation flow before entering the boiler section. The moisture separators recirculated flow through the annulus formed by the shell and tube bundle wrapper.

3.1.5.1 Technical Information in the Application

The applicant described its AMR of the steam generators for license renewal in Section 3.1.1 of the LRA, "Aging Management Review Results Tables," as supplemented by the April 15, 2002, response to the RAI. The staff reviewed this section of the LRA to determine whether the applicant had demonstrated that the effects of aging for the steam generators will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In accordance with the Catawba and McGuire UFSARs, the steam generators are designed and fabricated in accordance with Section III of the ASME Boiler and Pressure Vessel Code requirements. The SG tubes and plugs are made from corrosion resistant, thermally treated Inconel 690 for the BWI SGs and Inconel 600 for the W SG. The channel head divider plate is nickel-based alloy. The material used for the steam generator shell is made from low-alloy steel. The interior surfaces of the reactor coolant channel heads and nozzles are clad with austenitic stainless steel. The primary nozzles for the BWI SGs are buttered with nickel-based alloy weld material. The primary side of the tubesheets is weld clad with Inconel. The tubes are hydraulically expanded for the full depth of the tubesheets and the ends are seal welded to the tubesheet cladding. Primary nozzles have stainless steel safe ends. The primary manway is made of low-alloy steel clad with stainless steel (W) and nickel-based alloy (BWI). The secondary side components, including the steam drum, manways and their covers, handheld covers, handheld pad, and minor nozzle bosses, are all made from low-alloy steel. Although the LRA states that the RSGs have stainless steel flow restrictors, the applicant informed the staff, in a letter dated November 21, 2002, that the flow restrictors in only the replacement steam generators used in McGuire 1 and 2 and Catawba 1 are made of stainless steel. However, the flow restrictors in the Catawba 2 original steam generators are made of nickel-based alloy.

The SG components on the primary side are exposed to borated reactor water, while on the secondary side, treated water is maintained to minimize corrosion and fouling of the SG heat transfer surfaces. The design temperatures for all SGs are 343.3 °C (650 °F) on the reactor coolant side, and 315.6 °C (600 °F) on the steam side. The design pressure on the reactor coolant side is 17.13MPa (2485 psig), and 8.17 MPa (1185 psig) on the steam side. As stated in Section 3.2 of the Catawba UFSAR, the ASME classification for the secondary side is specified ASME Class 2. However, as stated in Section 5.4.2.3 of the Catawba UFSAR, the current philosophy is to design all pressure retaining parts of the SG, including both the primary and secondary pressure boundaries, to satisfy the criteria specified in Section III of the ASME Code for Class 1 components. This is applicable to RSGs where the analysis set includes not only transients associated with the Class 1 portion of these SGs, but also the transients applicable to certain non-Class 1 portions of these SGs.

3.1.5.1.1 Aging Effects

In LRA Table 3.1-1, the applicant, in accordance with 10 CFR 54.4(a), has identified that maintaining the structural integrity of the reactor pressure boundary is the applicable intended function for most steam generator components. The flow restrictor has an additional thermal-hydraulic intended function involving the provision of throttling, such that the appropriate fluid flow and pressure are supplied by the system.

The following aging effects associated with the SG components that require aging management are also listed in Table 3.1-1 of the LRA:

- loss of material in both borated and treated water for carbon steel, low-alloy steel, stainless steel, and nickel-based alloys
- cracking in carbon steel, low-alloy steel, stainless steel (including cladding materials), and nickel alloy steels (including buttering material)
- loss of preload in low-alloy steel bolting

3.1.5.1.2 Aging Management Programs

In Table 3.1-1 of the LRA, Duke identifies the AMPs for managing aging effects associated with the SG components. The aging effects for the SG components are given as cracking, loss of material, and loss of preload. In this table, the applicant lists the following applicable AMPs and activities for managing these aging effects associated with the SG components:

- Chemistry Control Program
- Fluid Leak Management Program
- ISI Plan
- Alloy 600 Aging Management Review
- Flow-Accelerated Corrosion Program
- Steam Generator Surveillance Program

The applicant concluded that these AMPs will manage the effects of aging, such that the intended function of the SG components will be maintained consistent with the CLB under all design loading conditions throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

The applicant did not specifically identify any TLAA in Section 3.1.1 of the LRA that is applicable to SG components. However, Section 4.0 of the LRA identifies a TLAA for metal fatigue of ASME Class 1 and Class 2 components that applies to SG components.

3.1.5.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.1.1 (including Table 3.1-1) of the LRA, and pertinent sections of LRA Appendices A and B, regarding the applicant's demonstration that the effects of aging will be adequately managed, so that the intended function(s) of the SG components will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

Table 3.1-1 of the LRA lists the SG components that are within the scope of the license renewal and identifies the aging effects that require management. The list of components within the scope of license renewal are grouped in accordance with their component types.

3.1.5.2.1 Aging Effects

In accordance with Section 3.1 of the LRA, the applicant has performed a review of industry experience, and NRC generic communications, relative to the SG components to provide reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for Catawba and McGuire. This also included the plant-specific operating experience at both subject plants.

The three aging effects for the steam generator given in Table 3.1-1 of the LRA follow:

- loss of material
- cracking
- loss of preload

In accordance with Section 5.4.2.1.3 of the Catawba UFSAR, additional measures are incorporated in the Westinghouse model D5 design to prevent areas of dry out in the SG and accumulation of sludge in low velocity areas. Modifications to the wrapper have increased water velocities across the tubesheets. A flow distribution baffle is provided which forces the low flow area to the center of the bundle. Increased capacity blowdown pipes have been added to enable continuous blowdown of the SGs at a high volume. Stainless steel tube support plates with broached tube holes minimize tube denting and support plate erosion/corrosion.

Similar design improvements in the RSGs by BWI address a number of SG internal degradation issues. Tube to tubesheet crevice intergranular attack is avoided by selection and control of the tube alloy, as well as development and implementation of the tube expansion tooling and procedures that minimize the crevice at the tubesheet secondary face. Tube to tubesheet crevice and primary side stress corrosion cracking (SCC) is avoided by using tube expansion techniques that minimize residual stresses. The accumulation of crud at the top of the tubesheet (tubesheet sludge piles) may be minimized through achievement of a high circulation ratio, high volume cross flow, high capacity blowdown capability, strict adherence to water chemistry limits, and provision of multiple access ports for sludge lancing. Use of "open-flow" lattice grids and stainless steel in the tube support designs limits corrosion product accumulation at tube supports and reduces denting at tube support locations. Tube vibration fretting wear at lattice grid and U-bend supports is avoided by maintaining optimum tube-to-support contact/clearance, installing U-bend supports, and selecting tube support material that resists wear when in direct contact with Inconel 690 interfaces. U-bend cracking of inner row tubes is avoided by using large minimum radius bends and stress relieving in the tightest bends.

Loss of material due to erosion and corrosion is considered significant for SG components in the secondary side which are fabricated from either carbon steel or low-alloy steel. The primary manway bolted connection is susceptible to boric-acid corrosion when exposed to reactor water leaks. Industry experience also has shown that loss of material can occur in nickel-based alloy SG tubes as a result of pitting/crevice corrosion. Vibration of the SG components may result in loss of material as a result of wear. In Table 3.1-1 of the LRA, the applicant has identified loss of material as an applicable aging effect for all SG components. The staff finds this acceptable because the applicant has conservatively accounted for loss of material in the SG components that could be induced by either flow-assisted corrosion, boric acid corrosion pitting or crevice corrosion, or wear.

Cracking of SG components due SCC, primary water stress corrosion cracking (PWSCC), intergranular stress corrosion cracking (IGSCC), or outside diameter stress corrosion cracking (ODSCC) is an applicable aging effect. SCC results from the synergistic effects of tensile stresses and a corrosive environment on a susceptible material. SCC is a particular concern for the SG tubes, and tube support plates, given the potential for occluded environmental conditions in crevice areas. Welds in the nozzles and their safe ends are also vulnerable to cracking. In Table 3.1-1 of the LRA, the applicant has identified cracking as an applicable aging effect for most SG components. The staff finds this acceptable because the applicant has conservatively accounted for cracking in the SG components that are susceptible to cracking by SCC, PWSCC, IGSCC, or ODSCC. Cracking of SG components by thermal fatigue is addressed in Section 4.3 of the application. The staff's evaluation of cracking of SG components by thermal fatigue is documented in Section 4.3 of this SER.

Stress relaxation in the bolted connections under long-term exposure to high constant strain and elevated temperature may lead to loss of preload. The manway bolts and handhole bolts are susceptible to this aging effect. In Table 3.1-1 of the LRA, the applicant has identified loss of preload as an applicable aging effect for the SG bolting. The staff finds this acceptable because the applicant has conservatively accounted for potential losses of preload in SG bolted connections that could result from stress relaxation.

Catawba 1 completed its first fuel cycle of operation with the replacement SGs (BWR RSGs) in November 1997. Based on industry guidelines for inspection programs for steam generator internals, as described in NUREG/CR-6754, "Review of Industry Responses to NRC Generic Letter 97-06 on Degradation of Steam Generator Internals," the Catawba 1 SG tubing was inspected using eddy current testing, and the upper-bundle and tubesheet regions were inspected either visually or by remote video camera. Similar inspections were also completed on the BWI RSGs at Millstone 2 and Ginna. During SG internal inspections in these three plants after their first service period, it was determined that positioning of the U-bend support components could result in contact between peripheral tubes. The routine ongoing outage cycle inspections (by eddy current test and/or secondary side visual) will monitor the condition over time. No other evidence of degradation in the steam drum, upper bundle (U-bend), and tubesheet regions was observed during these inspections. The applicant has recognized this particular degradation, both in addressing the design improvements associated with BWI RSGs, and in the operating experience for the Steam Generator Surveillance Program in Section B.3.31 of the LRA.

In its April 15, 2002, response to RAI 2.3.1-4, which pertained to the staff's scoping and screening evaluation that is documented in Section 2.3.1.6 of this SER, the applicant added the SG tube supports to the scope of license renewal. The applicant identified that the tube supports for the SGs perform a support function to the pressure boundary function of the SG tubes, and include components such as lattice grid support plates, U-bend anti-vibration bars, the shroud, lattice ring and U-bend arch bars, stay rods, tube bundle wrapper, and the tube support plates. The applicant stated that these are fabricated from either alloy steel, stainless steel, or carbon steel, and are exposed to treated water conditions. The applicant stated both loss of material and cracking as applicable effects for the surfaces of tube support components that are exposed to treated water. The staff's evaluations of these materials in treated water conditions have been discussed in previous paragraphs of this section. The staff concludes that the applicant's identification of aging effects for the tube supports is acceptable because the applicant has conservatively accounted for mechanisms that could lead to loss of material or cracking in these components, as discussed in the previous paragraphs in this section.

On the basis of the description of the internal and external environments, materials used, and the applicant's review of industry and plant-specific experience, the staff concludes that the applicant has identified all aging effects that are applicable for the SG components.

3.1.5.2.2 Aging Management Programs

In Table 3.1-1 of the LRA, the applicant specified the following AMPs as being applicable to the steam generators:

- Chemistry Control Program
- Fluid Leak Management Program
- ISI Plan
- Alloy 600 Aging Management Review
- Flow-Accelerated Corrosion Program
- Steam Generator Surveillance Program

The Chemistry Control Program (Section B.3.6 of LRA Appendix B) provides water quality that is compatible with the materials of construction used for the McGuire and Catawba SG components in order to minimize loss of material and cracking. This program is developed based on plant TS requirements and on EPRI guidelines, which reflect industry experience.

The staff notes that, in Table 3.1-1, the Chemistry Control Program is used in conjunction with the ISI Plan to mitigate cracking and loss of material in some SG components. For other SG components, the Chemistry Control Program is complemented by the Alloy 600 Aging Management Review, the Steam Generator Surveillance Program, and the Flow-Accelerated Corrosion Program. The staff finds this general approach to the management of cracking and loss of material to be acceptable, since these additional programs are able to provide feedback on the effectiveness of the Chemistry Control Program during the period of extended operation.

For some SG components requiring AMRs, the applicant proposed that the Chemistry Control Program by itself would be capable of managing the effects of aging attributed to the components. In accordance with Table 3.1-1, the applicant stated that loss of material and cracking in the steam flow limiter, the feedwater thermal sleeves, the handhole diaphragm, and the auxiliary feedwater distribution system are managed by the Chemistry Control Program alone. By letter dated January 28, 2002, the staff requested, in RAI 3.1.5-1, additional clarification of how this AMP will be used to manage loss of material and cracking in these SG components. In its response dated April 15, 2002, the applicant stated that the Chemistry Control Program maintains the environment in the steam generators by controlling contaminants that could lead to loss of material and cracking. A review of the operating experience has not identified any failures due to inadequate chemistry control. This operating experience shows that the Chemistry Control Program is effective in managing loss of material and cracking. Therefore, supplemental activities are not necessary.

Flow restrictors and steam flow limiters are located interior to feedwater/steam flow pipes and, as such, may not be readily accessible for the performance of ISIs. By letter dated January 28, 2002, the staff requested, in RAI 3.1.5-2, the applicant to clarify whether the feedwater flow restrictors were included in all of the SG designs for the McGuire and Catawba units, and to describe the types of ISIs performed on these components. In its response to RAI 3.1.5-2, dated April 15, 2002, the applicant clarified that the feedwater limiters (or flow restrictors) are only present in the Catawba 2 steam generators, and stated that the Chemistry Control Program provides aging management for the feedwater limiter. The applicant also stated that, for the steam flow restrictors identified in Table 3.1-1 (page 3.1-25, row 1) of the LRA, it had incorrectly credited the ISI plan as an aging management program, and that the Chemistry Control Program provides aging management for the steam flow restrictors. Based on the applicant's operating experience, as described in its responses to RAIs 3.1.5-1 and 3.1.5-2, the staff concludes that the Chemistry Control Program is effective in managing loss of material and cracking of the steam flow limiter, the feedwater thermal sleeves, the handhole diaphragm, and the auxiliary feedwater distribution system.

In a letter dated November 21, 2002, the applicant stated that it identified an error of omission in the Catawba/McGuire license renewal application that resulted in an incorrect statement in the NRC's safety evaluation report. In Table 3.1-1 of the original LRA submittal, the applicant identified stainless steel as the material of construction for the steam flow restrictors in all of the McGuire and Catawba steam generators. On the basis of the original submittal, the staff evaluated the aging effects and associated aging management program for the stainless steel steam flow restrictor. However, in the November 21, 2002, letter, the applicant revised Table 3.1-1 to state that the flow restrictors in the McGuire 1 and 2 and Catawba 1 replacement steam generators are made of stainless steel. The flow restrictors in the Catawba 2 original steam generators are made of nickel-based alloy.

The applicant stated that the flow restrictor does not have a pressure boundary function because it is installed completely within the steam generator and is not attached to the secondary side pressure boundary. For the nickel-based alloy flow restrictor, the applicant identified loss of material and cracking as the aging effects, and credits the Chemistry Control Program to manage the aging effects. The staff finds that loss of material and cracking are correctly identified as the aging effects for nickel-based alloy material. The Chemistry Control Program maintains the environment in the steam generators by controlling contaminants that could lead to loss of material and cracking. The applicant stated that, based on the operating experience, there have been no failures caused by inadequate chemistry control. The staff concludes that the Chemistry Control Program is adequate to manage the aging effects on the nickel alloy flow restrictors in Catawba 2 steam generators.

The staff evaluated this common AMP and found it to be acceptable for managing the aging effects identified for the steam generators. The staff's evaluation of the Chemistry Control Program is documented in Section 3.0 of this SER.

The Fluid Leak Management Program (Section B.3.15 of LRA Appendix B) was developed by the applicant in response to NRC Generic Letter 88-05. Inspections are performed to provide reasonable assurance that borated water leakage from the reactor coolant pressure boundary does not lead to undetected loss of material on the external surface of RC piping and associated components, specifically for those made out of carbon steel or low-alloy steel. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for the steam generators. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

The ISI Plan (Section B.3.20 of LRA Appendix B) manages aging effects of loss of material, cracking, gross loss of preload, and gross reduction in fracture toughness. The scope of the ISI plan for Class 1 and Class 2 components complies with the requirements of ASME Section XI, Subsections IWB and IWC. The scope of these Section XI categories covers Class 1 and Class 2 SG components. Depending on the examination category, the methods of inspection may include visual, surface, and/or volumetric examination of weld locations susceptible to aging degradation. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for the steam generators. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

By letter dated November 14, 2002, the applicant submitted changes to the license renewal applications for McGuire 1 and 2 and Catawba 1 and 2 for staff review. One of the applicant's proposed changes was related to the steam generator divider plates. In Table 3.1-1 of the LRA, the applicant credited the inservice inspection plan for the aging management of the steam generator divider plates; however, during an inspection of the applicant's inservice inspection plan document (documented in NRC Inspection Report 50-369/02-06, 50-370/02-06, 50-413/02-06, 50-414/02-02, dated September 9, 2002), the NRC staff found that the inservice inspection plan does not include the steam generator divider plates. The applicant determined that the inservice inspection plan was incorrectly credited as an aging management program for the steam generator divider plates. The applicant stated that, because the actual aging management reviews did not take credit for the inservice inspection plan for the divider plates, this was an editorial error in Table 3.1-1 of the LRA.

The divider plate is located in the lower head of the steam generator and separates the hot leg primary coolant from the cold leg primary coolant. The applicant stated that the divider plate is the pressure boundary of the steam generator shell itself. The divider plate is welded to the steam generator shell using nickel-based alloy welds. The pressure boundary of the steam generator could be affected by cracking of the nickel-based alloy divider plate itself, or cracking of the nickel-based alloy weld joining the plate to the shell. The applicant identified cracking and loss of material as the aging effects for the divider plate. The applicant identified the Chemistry Control Program and the Alloy 600 aging management review to manage the aging effects on the divider plate. The Alloy 600 aging management review ensures that cracking for the nickel-based alloy components is adequately managed. The Chemistry Control Program ensures that loss of material of the nickel-based alloy components is adequately managed. The staff has found the applicant's Alloy 600 aging management review to be acceptable for managing the aging effects identified for the divider plate, as shown in Section 3.1.2.2.2 of this SER. The staff has found the Chemistry Control Program to be acceptable for managing the aging effects of loss of material in the divider plate, as shown in section 3.0.3.2 of this SER. On the basis of the information submitted, the staff concludes that, without considering the inservice inspection plan, the aging effects of the steam generator divider plate will be adequately managed by the appropriate aging management programs.

The Alloy 600 Aging Management Review, as described in Appendix B, Section B.3.1 of the LRA, ensures that cracking due to PWSCC for nickel-based alloy components is adequately managed and inspected by the ISI Plan and the Steam Generator Integrity Program. This program utilizes industry and Duke operating experience to define the additional inspection work that needs to be carried out in support of the AMPs identified above. The inspection methods and frequency of inspection for the Alloy 600/690, 82/182, and 52/152 locations for the period of extended operation will be adjusted as needed, based on the review. The staff has evaluated this AMP and found it to be acceptable for managing the aging effects identified for the steam generators. The staff's evaluation of this AMP is documented in Section 3.1.2.2.2 of this SER.

In LRA Table 3.1-1, the applicant has included the SG bolting as one of the SG components requiring aging management. Loss of preload for the manway and handhole cover bolts/studs is covered by the SG bolting group. Table 3.1-1 of the LRA identified that three aging effects, including cracking, loss of material, and loss of preload, will be managed using the ISI plan and the fluid leak management program. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for steam generators. The staff's evaluation of these programs is documented in Sections 3.0.3.9.1 and 3.0.3.6 of this SER, respectively.

The Flow-Accelerated Corrosion Program, as described in Appendix B, Section B.3.14 of the LRA, is designed to manage loss of material from the carbon steel components due to FAC. The applicant states that inspection methods include volumetric examinations using ultrasonic testing and radiography to measure component wall thickness, and visual inspections when access to interior surfaces is possible. The applicant states that this AMP is consistent with the basic guidelines of EPRI Report NSAC-202L, "Recommendations for an Effective Flow-Accelerated Corrosion Program." The feedwater, auxiliary feedwater, and steam outlet nozzles are susceptible to FAC. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for steam generators. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

The Steam Generator Surveillance Program, as described in Section B.3.31 of LRA Appendix B, is designed to manage the loss of material and cracking of Alloy 600 and 690 steam generator tubes, including plugs and sleeves and internal support structures. The applicant stated that this program is based upon Technical Specification requirements, NEI 97-06, and the EPRI PWR Steam Generator Examination Guidelines. The inspections of the tubes and rolled plugs is by eddy current, and those plugs not accessible for eddy current examinations are visually inspected. Table 3.1-1 indicated that only the tubes and tube plugs are identified as applicable to this AMP.

In RAI 2.3.1-4, which pertained to the staff's scoping and screening evaluation that is documented in Section 2.3.1.6.2 of this SER, the staff asked whether it was appropriate to exclude the SG tube support components for McGuire and Catawba from the scope of license renewal. In its April 15, 2002, response to RAI 2.3.1-4, the applicant stated that the SG tube supports are within the scope of license renewal and were subject to AMRs. In its response, the applicant identified that the tube support structures include items such as lattice grid support plates, U-bend anti-vibration bars, the shroud, lattice ring and U-bend arch bars for the replacement steam generators used in the McGuire 1 and 2 and Catawba 1 SG designs, and anti-vibration bars, stay rods, tube bundle wrapper, and tube support plates for the Catawba 2 SG designs. The AMR results table for these components, which was provided in the applicant's response to RAI 2.3.1-4, identifies these components as "Tube Supports" and listed cracking and loss of material as applicable effects for these components. The applicant has credited the Chemistry Control Program (specifically for treated water) and the Steam

Generator Surveillance Program to manage loss of material and cracking in the SG tube support components. The staff has evaluated the Chemistry Control Program as a common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of the Chemistry Control Program is documented in Section 3.0 of this SER. The staff's evaluation of the Steam Generator Surveillance Program follows.

Steam Generator Surveillance Program

The applicant describes its Steam Generator Surveillance Program in Appendix B, Section B.3.31 of the LRA. This section of the LRA describes the applicant's evaluation of this program in terms of aging management program attributes provided in the Standard Review Plan for license renewal. The applicant credits this program as managing the effects of aging for the steam generators at all four units.

The staff reviewed the applicant's description of the program to determine whether the applicant had demonstrated that it will adequately manage the applicable effects of aging in selected steam generator components during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The Steam Generator Surveillance Program provides a comprehensive examination of the steam generator tubes and tube supports to ensure that degradation is identified, and corrective actions are taken prior to exceeding allowable limits. This program is a condition monitoring program that is credited for managing loss of material and cracking of Alloy 600 and 690 steam generator tubes and carbon steel and/or stainless steel tube supports.

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Appendix B, Section B.3.31, regarding the applicant's demonstration of the Steam Generator Surveillance Program to ensure that the aging effects of loss of material and cracking will be adequately managed, so that intended functions will be maintained consistent with the CLB for the period of extended operation.

The applicant credited the McGuire/Catawba Steam Generator Surveillance Program for managing aging effects in the McGuire/Catawba SG components. The staff evaluated the Steam Generator Surveillance Program on the following seven program attributes for the program:

1. program scope
2. preventive actions
3. parameters monitored or inspected
4. detection of aging effects
5. monitoring and trending
6. acceptance criteria
7. operating experience

The staff's evaluations of these program attributes are documented in the paragraphs that follow. The staff's evaluation of the other three program attributes (confirmatory actions, corrective actions, and administrative controls) for the Steam Generator Surveillance Program is documented in Section 3.0.4 of this SER.

[Program Scope] The scope of the Steam Generator Surveillance Program includes all steam generator tubes (including plugs and sleeves) in each steam generator and internal support structures. The staff issued an RAI to clarify whether the applicant is referring to internal support structures that are directly associated with the tubes themselves, or whether the program is designed to monitor the supports for other steam generator internal components. In its response to RAI 2.3.1-4, the applicant stated that tube support structures on the secondary side of the steam generators are subject to aging management review. The tube support structures include items such as lattice grid support plates, U-bend anti-vibration bars, the shroud, lattice ring, and U-bend arch bars for the replacement steam generators (McGuire 1 and 2 and Catawba 1). For Catawba 2, items such as anti-vibration bars, stay rods, tube bundle wrapper, and tube support plates are included. These items are included as "tube supports," and the aging management review results are presented in the applicant's response to this concern. On the basis of this evaluation, the applicant, in its response, stated that Table 3.1.1 of the LRA is supplemented with additional information. The SG tube support components are made out of carbon steel, low-alloy steel, and stainless steel. They are susceptible to cracking and loss of material aging effects. In order to maintain the support function of these SG components, the applicant has credited this program. The staff considers the scope of Duke's inspection program acceptable because, as discussed below, it meets both Duke's TS and current industry guidelines, and is adequate to detect degradation of steam generator tubes and internal structures that can affect tube integrity.

[Preventive Actions] The applicant stated that no preventive actions are taken as part of this inspection program to prevent aging effects or to mitigate aging degradation, and the staff did not identify a need for any.

[Parameters Monitored or Inspected] The application stated that the AMP monitors steam generator tube wall degradation and support plate locations. The applicant also stated that the recommendations for steam generator inspections given in NEI 97-06, "Steam Generator Program Guidelines," and the EPRI PWR Steam Generator Examination Guidelines will be followed as part of this AMP. These guidelines provide, among other things, criteria for the qualification of personnel, specific techniques, and the associated acquisition and analysis of data (including the procedure, probe selection, analysis protocol, and reporting criteria). Following the EPRI guidelines, Duke performs the appropriate type of eddy current test techniques depending on the region of the steam generator (e.g., top of the tubesheet, freespan). Inspection of tubes and plugs is carried out using eddy current examination. Tube plugs that cannot be examined in this way are examined visually. In addition to eddy current testing of SG tubes for tube wall degradation and support plate locations, visual inspections of SG internal components, loose parts monitoring, sludge pile location monitoring, and inspection of welds are performed to monitor the overall condition of the steam generator. The staff considers the parameters monitored (e.g., eddy current test and visual inspection results) acceptable because industry operating experience has demonstrated that the data obtained from these non-destructive examinations provide reasonable assurance that the effects of aging on steam generator tubes and plugs will be detected.

[Detection of Aging Effects] The applicant referred to information in the "Monitoring and Trending" section of the AMP for a description of the procedures for detecting aging effects. Aging effects are detected through inspection of the steam generators following the Improved Technical Specification (ITS) requirements and recommendations of the NEI 97-06, "Steam Generator Program Guidelines," and EPRI PWR Steam Generator Examination Guidelines.

The staff finds this overall approach for the detection of aging effects to be acceptable because the steam generator tube inspection is based on inspection methods, as specified in the ITS, NEI 97-06, and the EPRI PWR Steam Generator Examination Guidelines, that will be capable of detecting the aging effects identified by the applicant as being applicable to the SG components within the scope of the Steam Generator Surveillance Program.

[Monitoring and Trending] The applicant monitors degradation from cycle to cycle as part of its commitment to NEI 97-06. The condition monitoring program applied at these units uses inspection results to ensure that steam generator tube integrity has been maintained over the past operating cycle. The applicant also considers the inspection results in its operational assessment for the upcoming cycle to ensure that the tubes will perform their intended function and remain within the licensing basis requirements. The staff considers this acceptable since the program ensures that licensing basis requirements are maintained.

[Acceptance Criteria] Acceptance criteria for the Steam Generator Surveillance Program are included in Technical Specification 5.5.9.4. In addition, data are evaluated to determine that all structural and leakage criteria were met during the past operating cycle. A projection is made by an operational assessment to determine that all tubes left in service will continue to meet licensing basis requirements until the next examination. The staff finds these acceptance criteria to be acceptable because they are based on licensing basis requirements and technical specification requirements.

[Operating Experience] The applicant stated that the McGuire 1 and 2 steam generators were replaced in 1997 and 1998, respectively. The applicant stated that the only degradation that has been identified in the replacement steam generators for these two units is caused by wear at the secondary side U-bend fan bar and lattice grid supports.

After the Catawba 1 SG replacement in 1996, wear at the secondary side U-bend fan bar supports was also detected. The Catawba 2 steam generators have not been replaced. Wear was detected in the Catawba 2 steam generators at the edge of anti-vibration bars and in the preheater section. Tube wear occurs because of interaction between the secondary side of the tubes with steam generator tube support structures. The applicant stated that the operating experience at Catawba has revealed that wear on the secondary side is very slow and readily detectable by eddy current before it is severe enough to affect tube structural integrity. The staff finds that Duke's operating experience to date and the inspection program (which is based on standards, recommendations, and requirements used throughout the industry) supports the applicant's conclusion that the Steam Generator Surveillance Program is effective.

FSAR Supplement: Subsection (d) of 10 CFR 54.21 requires that the FSAR supplement for the facility must contain a summary description of the programs and activities for managing the effects of aging and the evaluation of time-limited aging analyses for the period of extended operation. For a description of the applicant's Steam Generator Surveillance Program, the applicant provided a reference to ITS 5.5.9 in Table 18-1 of LRA Appendices A.1 and A.2 for McGuire and Catawba, respectively. The staff found that the ITS provides a description of some of the Steam Generator Surveillance Program elements; however, it does not mention the inspection recommendations provided in NEI 97-06. LRA Section B.3.31 states that, in addition to the technical specification requirements, steam generator tube inspection follows the recommendations of the NEI 97-06 and EPRI PWR Steam Generator Examination Guidelines. ITS 5.5.9 does not reference NEI 97-06 or the EPRI guidelines. The staff has not approved

NEI 97-06 or the EPRI guidelines; however, the staff recognizes that these two industry documents provide guidance in the development of a steam generator management program, including steam generator inspection program specifications. The steam generator management program augments the requirements of ITS 5.5.9. Therefore, the staff requested the applicant to include a reference to NEI 97-06 in a summary description of the AMP, or in Table 18-1 of the McGuire and Catawba FSAR supplements. This issue was characterized as SER open item 3.1.5-1.

In its response dated October 28, 2002, the applicant proposed to modify the FSAR supplement summary description of this program. The proposed modifications follow:

1. In Table 18-1, for the Steam Generator Surveillance Program, the applicant proposed to add "18.3 " under the "UFSAR/ITS Location" column to reference the location of the Steam Generator Surveillance Program in the FSAR supplement.
2. The applicant proposed to create a new section, Section 18.3, in the FSAR supplement and include the following statement in Section 18.3, "The inspections of the Steam Generator Surveillance Program follow the recommendations of NEI 97-06, 'Steam Generator Program Guidelines.'"

The staff finds the proposed changes acceptable because the modified FSAR supplement summary description will be consistent with the Steam Generator Surveillance Program described in Appendix B, Section B.3.31, of the Catawba and McGuire LRA. The staff concludes that open item 3.1.5-1 is closed.

On the basis of the review of the Steam Generator Surveillance Program, the staff finds that the implementation of this program will provide reasonable assurance that cracking and loss of material of steam generator tubes and tube supports will be adequately managed, such that the intended function(s) of the steam generators will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.5.3 Conclusions

The staff reviewed the information included in Section 3.1.1 of the LRA, as supplemented by the April 15, 2002, response to the RAI. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the SG components will be adequately managed, so that there is reasonable assurance that these components will perform their intended function(s) consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.6 Aging Management Review for Class 1 Closure Bolting

Although the LRA provided AMR results for Class 1 bolting, it did not address bolting for non-Class 1 components. By letter dated January 23, 2002, the staff requested, in RAI 3.2-1, additional information that pertains to tables in Sections 3.2, 3.3, and 3.4 of the LRA that list closure bolting as components subject to an AMR. The staff stated that since closure bolting is exposed to air, moisture, and leaking fluid (boric acid) environments, it is subject to the aging effect of loss of material and crack initiation and growth. Tables in Sections 3.2, 3.3, and 3.4 do not address these aging effects for closure bolting in these systems. The staff requested the applicant to identify the AMR results for closure bolting, or to provide a justification for excluding closure bolting from an AMR, the results of which are documented in the referenced tables of the LRA.

3.1.6.1 Aging Effects

In its response dated April 15, 2002, the applicant stated that closure bolting used in mechanical system applications would be addressed. Closure bolting in mechanical system applications can be divided between Class 1 and non-Class 1 applications. Although the LRA addressed Class 1 bolting, the applicant described its treatment of this bolting in its response. The applicant stated that Class 1 bolting associated with the RCS is covered by specific ASME Section XI activities and is addressed in Section 3.1 of the LRA. Non-Class 1 bolted closures are considered a subcomponent of the components listed in the tables in LRA Sections 3.2, 3.3, and 3.4 of the LRA. Closure bolting exposed to air, moisture, and leaking fluid (boric acid) environments is subject to aging as a part of the bolted closure to which it belongs. Loss of material is the aging effect requiring management during the period of extended operation for carbon and low-alloy steel fastener sets of bolted closures.

3.1.6.2 Aging Management Programs

The Fluid Leak Management Program and the Inspection Program for Civil Engineering Structures and Components are credited with managing this aging effect during the period of extended operation. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects of Class 1 bolting. The staff's evaluation of these common AMPs is documented in Section 3.0 of this SER.

3.1.6.3 Conclusions

On the basis of its review of the RAI response pertaining to Class 1 bolting, the staff finds that all applicable aging effects were identified, and the aging effects identified are appropriate for the combination of materials and environments identified. The Fluid Leak Management Program and the Inspection Program for Civil Engineering Structures are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for Class 1 closure bolting. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. The staff concludes that the applicant has demonstrated that the aging effects associated with Class 1 bolting will be adequately managed, so that there is reasonable assurance that these components will perform their intended functions consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2 Aging Management of Engineered Safety Features

The applicant described its AMR of the engineered safety features (ESFs) for license renewal in Sections 2.3.2, "Engineered Safety Features," and 3.2, "Aging Management of Engineered Safety Features," of its LRA. The staff has reviewed these sections of the application to determine whether the applicant has provided adequate information to demonstrate that the effects of aging on ESF systems and components will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The LRA identified eight systems that will require aging management to meet the requirements of 10 CFR 54.21(a)(3) for management of aging effects. The eight systems are annulus ventilation, containment isolation, containment air return exchange and hydrogen skimmer, containment spray, containment valve injection water, refueling water, residual heat removal, and safety injection. The LRA included a summary of the results of the aging management review for the above listed eight systems. The results are presented in Tables 3.2-1 through 3.2-8 of the LRA. The tables provide the following information: (1) component type, (2) component function, (3) material, (4) environment, (5) aging effects requiring management, and (6) the aging management programs that manage the identified aging effects.

Section 3.2 of the LRA defined the external and internal environments applicable to the ESF systems as follows—

- Air-Gas — Compressed air is ambient air that has been filtered and compressed for use in plant equipment. Compressed air may be either dry or oiled. Compressed gasses include carbon dioxide, hydrogen, nitrogen, freon, or refrigeration gasses used to replace freon due to environmental concerns.
- Borated Water — Borated water is demineralized water treated with boric acid.
- Raw Water — Raw water is water from a lake, pond, or river that has been rough-filtered and possibly treated with a biocide.
- Treated water — Treated water is demineralized water that may be deareated, treated with a biocide or corrosion inhibitors, or a combination of these treatments. Treated water does not include borated water, which is evaluated separately.
- Sheltered environment — The ambient conditions within the sheltered environment may or may not be controlled. The sheltered environment atmosphere is a moist air environment. Components in systems with external surface temperatures the same or higher than ambient conditions due to normal system operation are expected to be dry.
- Reactor Building — The Reactor Building environment is moist air. Components in systems with external surface temperatures the same or higher than ambient conditions due to normal system operation are expected to be dry.
- Ventilation — Ambient air that is conditioned to maintain a suitable environment for equipment operation and personnel occupancy.
- Yard — Yard environment is a moist air environment in which equipment is exposed to heat, cold, and precipitation.

To provide reasonable assurance that the aging effects that require management for a specific material-environment combination are the only aging effects of concern for McGuire and Catawba, Duke also performed a review of industry experience and NRC generic communications relative to the ESF SSCs. In addition, relevant McGuire and Catawba operating experience has been reviewed to provide additional confidence that the set of aging effects for the specific material-environment combinations have been identified.

3.2.1 Annulus Ventilation System

3.2.1.1 Technical Information in the Application

The McGuire annulus ventilation system is an ESF that creates and maintains a negative pressure zone in the annular space between the steel primary containment and reactor building (secondary containment) to prevent the leakage of radioisotopes through the reactor building and into the environment following a loss-of-coolant accident (LOCA). The annulus ventilation system is also designed to maintain containment isolation integrity. The Catawba annulus ventilation system is an ESF, used in conjunction with the secondary containment to limit operator and site boundary doses following a design basis accident, and to provide long-term fission product removal capability within the annulus through holdup and filtration.

3.2.1.1.1 Aging Effects

Table 3.2-1 of the LRA identified the following components that will require aging management during the period of extended operation: air flow monitors, ductwork, filters, pipe, tubing, and valve bodies. The applicant identified stainless steel, carbon steel, copper, and brass as the materials of construction for the annulus ventilation components. The applicant also indicated that the environments to which these components are exposed include an internal environment of ventilation and external environments of sheltered or reactor building. The applicant identifies only loss of material as an applicable aging effect for carbon steel, copper, and brass that are exposed to an external environment.

3.2.1.1.2 Aging Management Programs

The LRA identified the following two aging management programs to manage the aging effects on the annulus ventilation system during the period of extended operation:

- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components

The applicant stated that the Fluid Leak Management Program and Inspection Program for Civil Engineering Structures and Components will be used to manage the loss of material associated with carbon steel materials. The Fluid Leak Management Program will also be used to manage the loss of material associated with brass and copper materials. A detailed description concerning each of the programs identified above is included in Appendix B of the LRA, along with the applicant's discussion of how identified aging effects will be effectively managed for the period of extended operation.

3.2.1.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2 of the LRA. The purpose of the review was to ascertain whether the applicant has adequately demonstrated that the effects of aging associated with the annulus ventilation system will be adequately managed, so that the intended function of the systems will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.1.2.1 Aging Effects

The LRA included a summary of the results of the aging management review for the annulus ventilation system. The results are presented in Table 3.2-1 of the LRA. The materials of construction, internal/external environment, and aging effects for the annulus ventilation system are—

- stainless steel in ventilation/sheltered/reactor building environments — no aging effects
- carbon steel, brass, copper in ventilation environments — no aging effects
- carbon steel in sheltered/reactor building environments — loss of material
- brass, copper in sheltered/reactor building environments — loss of material

No aging effects were identified for air flow monitors, ductwork, filters, tubing, and valve bodies made of stainless steel in ventilation or sheltered environments. Austenitic stainless steel materials are designed to be corrosion resistant in both dry or moist air environments. Cracking and corrosion generally have not been a problem for austenitic stainless steel components in ventilated air, sheltered air, or reactor building air environments. Therefore, the applicant has not identified any applicable aging effects for the surfaces of stainless steel annulus ventilation system components exposed to these types of air environments.

No aging effects were identified for carbon steel pipe and valve bodies in a ventilated air environment. The air temperature, humidity, and component temperatures do not provide a corrosive environment that would lead to aggressive general corrosion.

Loss of material was identified for carbon steel pipe and valve bodies in sheltered air or reactor building air environments. Loss of material of carbon steel materials by corrosion may result in moist air environments and, therefore, may be an applicable aging effect for the surfaces of carbon steel that are exposed to sheltered air. In addition, borated water leaks from other plant systems may also cause loss of material of carbon steel components. The applicant will use the Fluid Leak Management Program and Inspection Program for Civil Engineering Structures and Components to manage the loss of material associated with carbon steel pipe and valve bodies.

Loss of material was identified for brass tubing, brass valve bodies, and copper tubing in the sheltered environment. Brass and copper are corrosion resistant in both dry or moist air environments. However, borated water leaks from other plant systems may cause loss of material of brass and copper components. The applicant will use the Fluid Leak Management Program to manage the loss of material associated with brass and copper materials.

In a letter dated November 14, 2002, the applicant submitted its response to SER open item 2.3-3 pertaining to the applicant's treatment of structural sealants (subcomponents of structural members) in certain ventilation system applications for which pressure boundary integrity was an intended function. The applicant identified cracking and shrinkage of structural sealants in the interface between a structural wall, floor, or ceiling, and a nonstructural component (such as a duct, piping, electrical cables, doors, and nonstructural walls) resulting from exposure to ambient conditions as potential aging effects.

The aging effects identified in LRA Table 3.2-1 and in correspondence from the applicant are consistent with industry experience for the combinations of materials and environments listed. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.2.1.2.2 Aging Management Programs

Table 3.2-1 of the LRA identified the following two aging management programs that will manage the aging effects on the annulus ventilation system during the period of extended operation:

- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components

In its November 14, 2002, response to SER open item 2.3-3, the applicant identified the Ventilation Area Pressure Boundary Sealants Inspection to manage the effects of cracking and shrinkage of structural sealant due to exposure to ambient conditions.

The Fluid Leak Management Program, the Inspection Program for Civil Engineering Structures and Components, and the Ventilation Area Pressure Boundary Sealants Inspection are credited with managing the aging of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.2-1 and correspondence from the applicant, the staff concludes that the above identified AMPs will effectively manage the aging effects of the annulus ventilation system, and that there is reasonable assurance that the intended functions of the annulus ventilation system will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.1.3 Conclusions

The staff reviewed the information in Section 3.2, "Aging Management of Engineered Safety Features," of the LRA and in correspondence from the applicant . The staff considered both industry and plant-specific experience. On the basis of its review, the staff concludes that the applicant's characterization of the aging effects associated with the annulus ventilation system is consistent with published literature and industry experience. The staff further concludes that the applicant has appropriate aging management programs to effectively manage the aging effects of the annulus ventilation system, and that there is reasonable assurance that the intended functions of the system will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2 Containment Isolation System

3.2.2.1 Technical Information in the Application

The containment isolation system is an ESF that prevents the leakage of uncontrolled or unmonitored radioactive materials to the environment by closing all fluid penetrations not required for operation of the Engineered Safeguards System. The LRA identifies the following 12 subsystems of the containment isolation system:

Breathing air system: The McGuire breathing air system provides an adequate capacity of air to meet appropriate American National Standards Institute (ANSI) specifications. The breathing air system is also relied upon to provide and maintain containment isolation and closure. The Catawba breathing air system supplies clean, oil free, compressed air to various locations in the auxiliary building, monitor tank building, and containment for breathing protection against airborne contamination during the performance of certain maintenance and cleaning operations.

Containment air release and addition system: The McGuire containment air release and addition system maintains containment pressure between the McGuire Technical Specification limits of -0.3 to +0.3 psig. Increases in pressure during normal operation are controlled by venting the containment through the containment air release and addition filters. The Catawba containment air release and addition system maintains containment pressure between the Catawba Technical Specification limits of -0.1 to +0.3 psig during normal plant operation. An increase in pressure during normal operation is controlled by the containment air release fans taking suction from the containment and passing through the containment air release filters.

Containment hydrogen sample and purge system: The McGuire Nuclear Station has no system corresponding to the Catawba containment hydrogen sample and purge system. The Catawba containment hydrogen sample and purge system is used after a loss-of-coolant accident (LOCA) to monitor the hydrogen concentration inside containment, and if necessary, reduce the levels of hydrogen by manually purging the hydrogen from containment into the annulus.

Containment purge ventilation system: During periods of sustained personnel access (including refueling), the McGuire containment purge ventilation system reduces the airborne radioactivity levels in containment by purging the upper containment atmosphere to the environment via the unit vent stack. The Catawba containment purge system reduces the airborne radioactivity levels in containment by purging the upper containment, lower containment, and the in-core instrumentation room atmosphere to the unit vent stack when periods of personnel access are required.

Containment ventilation cooling water system: The McGuire containment ventilation cooling water system operates in conjunction with the nuclear service water system to supply cooling water to ventilation units located in the reactor and auxiliary buildings. Catawba does not have a containment ventilation cooling water system. The comparable components cooled by the McGuire containment ventilation cooling water system are cooled by the Catawba nuclear service water system.

Conventional chemical addition system: The McGuire conventional chemical addition system uses the auxiliary feedwater supply headers to provide chemical addition to the steam generators. Catawba does not have a conventional chemical addition system. The comparable components to the McGuire conventional chemical addition system are contained in the Catawba auxiliary feedwater system.

Equipment decontamination system: The McGuire equipment decontamination system provides decontamination of station equipment before personnel use. The original design of McGuire included containment isolation capability; however, the design was modified by the installation of a sleeve cap on the annulus side of the penetration, thereby removing the containment isolation function. Associated with the capped penetration are remaining components, including piping. The applicant determined that these components have no component intended function. Therefore, no mechanical components in the equipment decontamination system are subject to aging management review. The Catawba equipment decontamination system provides cleaning and decontamination of radioactive equipment prior to handling, maintenance, or shipping. The equipment decontamination system and its components are not safety-related, with the exception of the portions associated with containment isolation. The equipment decontamination system is relied upon to maintain two trains of containment isolation and maintain containment closure for shutdown.

Ice condenser refrigeration system: The primary safety function of the McGuire and Catawba ice condenser refrigeration systems is to rapidly reduce the containment pressure and temperature following any LOCA and maintain them at acceptable levels, consistent with the operation of other associated systems. The safety-related function of the mechanical systems portion of the ice condenser refrigeration system is containment isolation.

Makeup demineralized water system: The McGuire and Catawba makeup demineralized water systems provide treated and demineralized water to various plant systems and components.

Station air system: The McGuire station air system provides an adequate capacity for general station service air requirements. Normally, the instrument air system provides the station air requirements through system cross-connect valves. However, if needed, one station air system compressor is provided to furnish the station air requirements if the instrument air system is not available or desired. The station air system is also relied upon to provide and maintain containment isolation and closure. The Catawba station air system supplies low pressure compressed air for air operated tools, miscellaneous equipment, and various maintenance purposes. The station air system, if required, is available to act as a backup supply of compressed air for the instrument air system. The station air system is relied upon to provide and maintain containment isolation and closure.

Steam generator blowdown recycle system: The McGuire and Catawba steam generator blowdown recycle systems are used in conjunction with the condensate system to maintain acceptable secondary side water chemistry and control corrosion product buildup. The steam generator blowdown recycle system is designed to maintain containment isolation integrity. The system automatically isolates the blowdown lines penetrating the containment following receipt of a containment isolation signal, and also following a start signal of the auxiliary feedwater system.

Steam generator wet lay-up recirculation system: The McGuire and Catawba steam generator wet lay-up recirculation systems maintain containment isolation integrity. The system contains piping and components that are used during containment isolation.

3.2.2.1.1 Aging Effects

Table 3.2-2 of the LRA identifies the following components of the containment isolation system that will require aging management: piping, tubing, orifices, annubars, and valve bodies. The applicant identified stainless steel, carbon steel, copper, brass, and transite, a non-metallic cement-asbestos material, as the materials of construction for the containment isolation components. The applicant identified the reactor building, sheltered, and embedded environments as the external environments, and raw water, treated water, borated water, air-gas, and ventilation environments as the internal environments. Loss of material was identified as an applicable aging effect for carbon steel, copper, and brass materials. Loss of material and cracking were identified as applicable aging effects for stainless steel materials.

3.2.2.1.2 Aging Management Programs

The LRA identified the following six aging management programs that will manage the aging effects on the containment isolation system during the period of extended operation:

- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components
- Service Water Piping Corrosion Program
- Galvanic Susceptibility Inspection
- Chemistry Control Program
- Flow-Accelerated Corrosion Program

Appendix B to the LRA contains a detailed description of the six previously discussed aging management programs. The LRA cites these programs as methods to manage aging effects of the containment isolation system components in the applicable environments.

3.2.2.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed Section 3.2 of the LRA. The purpose of the review was to determine whether the applicant will adequately manage the aging effects of the containment isolation system while maintaining the current licensing basis of the system's intended function.

3.2.2.2.1 Aging Effects

The LRA includes a summary of the results of the aging management review for the containment isolation system. The results are presented in Table 3.2-2 of the LRA. The materials of construction, internal/external environments, and aging effects for the containment isolation system are—

- stainless steel in air-gas/sheltered/reactor building/ventilation environment — no aging effects
- embedded transite, carbon and stainless steel — no aging effects

- carbon steel, brass, copper, and transite in ventilation environment — no aging effects
- carbon steel in sheltered/reactor building environment — loss of material
- brass and copper materials in reactor building environment — loss of material
- carbon steel in raw water environment — loss of material
- stainless steel in raw water environment — loss of material
- stainless steel in treated water environment — loss of material and cracking
- carbon steel in treated water environment — loss of material
- stainless steel in borated water environment — loss of material and cracking

No aging effects were identified for piping, tubing, orifices, annubars, and valve bodies made of stainless steel in air-gas, sheltered, reactor building, or ventilation environments. Austenitic stainless steel materials are designed to be corrosion resistant in dry or moist air environments. Cracking and corrosion, therefore, generally have not been a problem for austenitic stainless steel components in these environments. The applicant, therefore, did not identify any applicable aging effects for the surfaces of stainless steel components exposed to the above identified environments.

No aging effects were identified for pipe made of transite, carbon, or stainless steel in an embedded environment.

No aging effects were identified for carbon steel pipe and valve bodies in a ventilated air environment. The air temperature, humidity, and component temperatures do not provide a corrosive environment that would lead to aggressive general corrosion.

The applicant identified loss of material as an aging effect on carbon steel pipe and valve bodies in sheltered and reactor building environments. Loss of material of carbon steel materials by corrosion may occur in moist air environments and, therefore, may be an applicable aging effect. In addition, borated water leaks from other plant systems may also cause loss of material of carbon steel components. The applicant will use the Fluid Leak Management Program and the Inspection Program for Civil Engineering Structures and Components to manage the loss of material associated with carbon steel pipe and valve bodies.

The applicant identified loss of material as an aging effect on brass valve bodies, brass tubing, and copper tubing in the reactor building environment. Brass and copper are corrosion resistant in both dry or moist air environments. However, borated water leaks from other plant systems may cause loss of material of brass and copper components. The applicant will use the Fluid Leak Management Program to manage the loss of material associated with brass and copper materials.

The applicant identified loss of material as an aging effect on carbon steel pipe and valve bodies in the raw water environment. Loss of material from general corrosion, microbiologically induced corrosion (MIC), galvanic corrosion, and pitting corrosion can occur when carbon steel materials are in contact with raw water. The applicant will use the Galvanic Susceptibility Inspection and Service Water Piping Corrosion Program to manage the loss of material associated with carbon steel pipe and valve bodies.

The applicant identified loss of material as an aging effect on stainless steel orifices, annubars, tubing, and valve bodies in the raw water environment. Loss of material from galvanic, MIC, and pitting corrosion can occur when stainless steel materials are in contact with raw water. The applicant will use the Service Water Piping Corrosion Program to manage the loss of material associated with stainless steel orifices, annubars, tubing, and valve bodies.

The applicant identified loss of material and cracking as aging effects on stainless steel tubing, pipe, and valve bodies in the treated water environment. Loss of material and cracking of stainless steel in a treated water environment is a possible aging effect under certain conditions. Industry experience indicates that the presence of halogens in excess of 150 ppb and oxygen in excess of 100 ppb in stagnant or low flow conditions could lead to loss of material from and cracking of stainless steel in treated water. Therefore, the applicant will use the Chemistry Control Program to manage the loss of material and cracking in the treated water environment.

The applicant identified loss of material and cracking as aging effects on stainless steel in the borated water environment. Loss of material and cracking of stainless steel in this environment is a possible aging effect under certain conditions. Industry experience indicates that the presence of halogens in excess of 150 ppb, oxygen in excess of 100 pbb, and temperature in excess of 200 °F in stagnant or low flow conditions can lead to loss of material and cracking. Therefore, the applicant will use the Chemistry Control Program to manage the loss of material and cracking in the borated water environment.

The aging effects identified in LRA Table 3.2-2 are consistent with industry experience for the combinations of materials and environments listed. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.2.2.2.2 Aging Management Programs

In Table 3.2-2 of the LRA, the applicant identified the following programs that will manage the aging effects associated with the containment isolation system:

- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components
- Service Water Piping Corrosion Program
- Galvanic Susceptibility Inspection
- Chemistry Control Program
- Flow-Accelerated Corrosion Program

The Fluid Leak Management Program, Inspection Program for Civil Engineering Structures and Components, Service Water Piping Corrosion Program, Galvanic Susceptibility Inspection, Chemistry Control Program, and Flow-Accelerated Corrosion Program are credited with managing the aging of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.2-2, the staff concludes that the above identified AMPs will effectively manage the aging effects of the containment isolation system, and that there is reasonable assurance that the intended functions of the containment isolation system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.3 Conclusions

The staff reviewed the information in Section 3.2, "Aging Management of Engineered Safety Features," of the LRA. The staff considered both industry and plant-specific experience. On the basis of its review, the staff concludes that the applicant's characterization of the aging effects associated with the containment isolation system is consistent with published literature and industry experience. The staff further concludes the applicant has appropriate aging management programs to effectively manage the aging effects of the containment isolation system, and that there is reasonable assurance that the intended functions of the system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.3 Containment Air Return Exchange and Hydrogen Skimmer System

3.2.3.1 Technical Information in the Application

The McGuire and Catawba containment air return exchange and hydrogen skimmer system (1) maintains containment pressure less than the design pressure during any high energy line break (HELB), (2) ensures hydrogen concentration remains less than the flammability limit during a LOCA, and (3) maintains containment isolation integrity for the system piping penetrating the containment.

3.2.3.1.1 Aging Effects

Table 3.2-3 of the LRA identifies the following components that will require aging management: ductwork, expansion joints, pipe, tubing and valve bodies. The applicant identified stainless steel, carbon steel, copper, and brass as the materials of construction for the containment air return exchange and hydrogen skimmer components. Loss of material was identified as an applicable aging effect for carbon steel, copper, and brass exposed to the reactor building or a sheltered external environment.

3.2.3.1.2 Aging Management Programs

The LRA identifies the following two aging management programs that will manage the aging effects on the containment air return exchange and hydrogen skimmer systems during the period of extended operation:

- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components

The applicant indicated that the Fluid Leak Management Program and Inspection Program for Civil Engineering Structures and Components will be used to manage the loss of material associated with carbon steel materials. The applicant stated that the Fluid Leak Management Program will be used to manage the loss of material associated with copper and brass materials. Appendix B to the LRA contains a detailed description of those two aging management programs.

3.2.3.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed Section 3.2 of the LRA. The purpose of the review was to determine whether the applicant will adequately manage the aging effects of the containment air return exchange and hydrogen skimmer system while maintaining the current licensing basis of the system's intended function.

3.2.3.2.1 Aging Effects

The LRA includes a summary of the results of the aging management review for the containment air return and hydrogen skimmer system. The results are presented in Table 3.2-3 of the LRA. The materials of construction, internal/external environments, and aging effects for the containment air return exchange and hydrogen skimmer system are—

- stainless steel in air-gas/ventilation/sheltered/reactor building environment — no aging effects
- brass, copper, and carbon steel in ventilation environment — no aging effects
- brass and copper in reactor building environment — loss of material
- carbon steel in sheltered/reactor building environment — loss of material

No aging effects were identified for ductwork, expansion joints, piping, tubing, and valve bodies made of stainless steel in air-gas, sheltered, reactor building, or ventilation environments. Austenitic stainless steel materials are designed to be corrosion resistant in dry or moist air environments. Cracking and corrosion, therefore, generally have not been a problem for austenitic stainless steel components in these environments. The applicant, therefore, did not identify any applicable aging effects for the surfaces of stainless steel components exposed to the above identified environments.

The applicant identified loss of material as an aging effect on carbon steel pipe and valve bodies in sheltered or reactor building environments. Loss of material of carbon steel materials by corrosion may occur in moist air environments and, therefore, may be an applicable aging effect. In addition, borated water leaks from other plant systems may also cause loss of material of carbon steel components. The applicant will use the Fluid Leak Management Program and Inspection Program for Civil Engineering Structures and Components to manage the loss of material associated with carbon steel pipe and valve bodies.

No aging effects were identified for brass and copper tubing and carbon steel pipe and valve bodies in a ventilated air environment. The air temperature, humidity, and component temperatures do not provide a corrosive environment that would lead to aggressive general corrosion.

The applicant identified loss of material as an aging effect on brass and copper tubing in the reactor building environment. Brass and copper are corrosion resistant in both dry or moist air environments. However, borated water leaks from other plant systems may cause loss of material of brass and copper components. The applicant will use the Fluid Leak Management Program to manage the loss of material associated with these materials.

The aging effects identified in LRA Table 3.2-3 are consistent with industry experience for the combinations of materials and environments listed. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.2.3.2.2 Aging Management Programs

Table 3.2-3 of the LRA credits the following two aging management programs for managing the aging effects on the containment air return exchange and hydrogen skimmer systems during the period of extended operation:

- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components

The Fluid Leak Management Program and the Inspection Program for Civil Engineering Structures and Components are credited with managing the aging of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.2-3, the staff concludes that the above identified AMPs will effectively manage the aging effects of the containment air return exchange and hydrogen skimmer system, and that there is reasonable assurance that the intended functions of the containment air return exchange and hydrogen skimmer system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.3.3 Conclusions

The staff reviewed the information in Section 3.2, "Aging Management of Engineered Safety Features," of the LRA. The staff considered both industry and plant-specific experience. On the basis of its review, the staff concludes that the applicant's characterization of the aging effects associated with the containment air return exchange and hydrogen skimmer system is consistent with published literature and industry experience. The staff further concludes that the applicant has appropriate aging management programs to effectively manage the aging effects of the containment air return exchange and hydrogen skimmer system, and that there is reasonable assurance that the intended functions of the system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.4 Containment Spray System

3.2.4.1 Technical Information in the Application

The applicant described its AMR for the containment spray system (CSS) in Section 3.2 of the LRA. The CSS removes thermal energy from the containment atmosphere in the event of a LOCA or main steam line break. The CSS performs this function in conjunction with the emergency core cooling systems, which cool the reactors during injection and recirculation modes of emergency operations. The heat removal capabilities of the CSS maintain the containment pressures to below the design pressure values after the ice in the respective ice condensers has been depleted. The CSS also serves to remove fission product iodine from the post-accident containment atmospheres.

3.2.4.1.1 Aging Effects

Table 3.2-4 of the LRA identified the following components that are subject to AMRs: flow orifices, heat exchangers and their subcomponents, piping, pump casings, spray nozzles, tubing, and valve bodies. In Table 3.2-4 of the LRA, the applicant identifies that the specific CSS components are fabricated from stainless steel materials, with the following exceptions:

- Portions of the CSS heat exchanger channel heads and shells are fabricated from carbon steel.
- Tubing for McGuire CSS heat exchanger 2NSHX0004 is fabricated from titanium instead of stainless steel.
- Portions of the Catawba CSS heat exchanger tubesheets are fabricated from carbon steel.

Loss of material was identified as an applicable aging effect for carbon steel materials. Loss of material and fouling were identified as applicable aging effects for heat exchanger tubes. Loss of material and cracking were identified with stainless steel materials.

3.2.4.1.2 Aging Management Programs

The applicant credits the following programs and activities for managing the aging effects identified for the CSS components:

- Borated Water Systems Stainless Steel Inspection
- Chemistry Control Program
- Fluid Leak Management Program
- Heat Exchanger Performance Testing Activities — Containment Spray Heat Exchangers
- Heat Exchanger Preventive Maintenance Activities — Containment Spray
- Inspection Program for Civil Engineering Structures and Components
- Service Water Piping Corrosion Program

3.2.4.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2 (including Table 3.2-4), and pertinent sections of LRA Appendices A and B, to ascertain that the effects of aging associated with CSS will be adequately managed, so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.4.2.1 Aging Effects

Table 3.2-4 of the application identifies which of these aging effects are applicable to the specific CSS components identified in the table as being within the scope of license renewal.

Specifically, Table 3.2-4 identifies the following aging effects for the material-environment combinations for the CSS components:

- stainless steel components in borated water environments — loss of material and cracking
- stainless steel or titanium tubes in raw water environments — loss of material and fouling
- titanium tubes in borated water environments — no aging effects identified
- other stainless steel components in raw water environments- loss of material
- stainless steel components in contact with sheltered air, ventilation air, or reactor building air environments — no aging effects identified
- carbon steel components in external sheltered air environments or internal raw water environments — loss of material

Industry experience and experimental data have demonstrated that austenitic stainless steel materials in borated water solutions may be susceptible to stress corrosion cracking or loss of material as a result of pitting or general corrosion, with elevated levels of oxidizing impurity species (i.e., oxygen, sulfates, halides, etc.) increasing the potential for these aging effects to occur. These aging effects are therefore applicable to the stainless steel CSS components in contact with borated water solutions. These aging effects are also applicable to portions of the stainless steel CSS piping (i.e., the CSS piping risers) that are exposed to alternating borated-wet and dry-air environments, as any oxidizing contaminants may concentrate in the piping sections and create an environment conducive to pitting or stress corrosion cracking. For stainless steel (or titanium) heat exchanger tubes exposed to raw water environments, the tubes may be susceptible to biological-induced fouling, which if unattended, has the potential to block the flow of coolant through the tubes and, in some cases, to produce corrosive environments that could lead to a loss of the tube material. The applicant has appropriately identified these aging effects (i.e., cracking, loss of material, fouling) in its analyses for the CSS stainless steel components that are exposed to borated or raw water sources, or to alternating borated-wet and dry-air environments.

Austenitic stainless steel materials are designed to be corrosion resistant in both dry or moist air environments. Therefore, cracking and corrosion generally have not been a problem for austenitic stainless steel components in ventilated air, sheltered air, or reactor building air environments. The applicant, therefore, has not identified any applicable aging effects for the surfaces of stainless steel CSS components exposed to these types of air environments. Based on these considerations, the staff concludes that the applicant's identification of the aging effects for stainless steel CSS components is acceptable.

The carbon steel CSS heat exchanger components are in contact with sheltered air environments on their external surfaces, and the carbon steel and stainless steel heat exchanger components are in contact with raw water on their internal surfaces. Loss of material of carbon steel materials by corrosion may result in moist air environments and, therefore, may be an applicable aging effect for the surfaces of carbon steel CSS heat exchanger components that are exposed to sheltered air. The surfaces of carbon steel CSS heat exchanger components that are exposed to raw water environments may be prone to loss of material as a result of general or localized corrosion, or by erosion from particulate, when the raw water flow velocities are high. The carbon steel CSS heat exchanger components in contact with stainless steel heat exchanger components may be prone to loss of material by corrosion, if the adjacent stainless steel heat exchanger component is subjected to an internal, corrosive borated water or raw water environment, and if the stainless steel component has cracked sufficiently to allow fluid to leak onto the external surfaces of the carbon steel component. The applicant has appropriately identified loss of material as an applicable aging effect for the carbon steel CSS heat exchanger components that are exposed to these environments.

The aging effects identified in LRA Table 3.2-4 are consistent with industry experience for the combinations of materials and environments listed. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.2.4.2.2 Aging Management Programs

Table 3.2-4 of the LRA states that the following aging managements programs are credited for managing the aging effects attributed to the CSS components:

- Borated Water Systems Stainless Steel Inspection
- Chemistry Control Program
- Fluid Leak Management Program
- Performance Testing Activities — Containment Spray Heat Exchangers
- Heat Exchanger Preventive Maintenance Activities — Containment Spray
- Inspection Program for Civil Engineering Structures and Components
- Service Water Piping Corrosion Program

The applicant will use the Fluid Leak Management Program (Section B.3.15 of LRA Appendix B) and the Inspection Program for Civil Engineering Structures and Components (Section B.3.21 of LRA Appendix B) to manage loss of material in carbon steel CSS components exposed to sheltered air environments. The applicant will use the Performance Testing Activities — Containment Spray Heat Exchangers (Section B.3.17.2 of LRA Appendix B) and the Heat Exchanger Preventive Maintenance Activities — Containment Spray (Section B.3.17.2 of LRA Appendix B) to manage fouling and loss of material in the heat exchanger tube surfaces (stainless steel or titanium) that are exposed to raw water environments, respectively. The applicant will use the Service Water Piping Corrosion Program (Section B.3.29 of LRA Appendix B) to manage the surfaces of carbon or stainless steel components exposed to raw water environments. The applicant will use the Chemistry Control Program (Section B.3.6 of LRA Appendix B) to manage loss of material and cracking in stainless steel CSS components exposed to borated water environments. As an added precaution, the applicant will use the Borated Water Systems Stainless Steel Inspection (Section B.3.4 of LRA Appendix B) as an added program for managing loss of material and cracking in the stainless steel CSS piping risers, as the risers may be subjected to periods of alternating wet, borated water and dry air environments.

The Borated Water Systems Stainless Steel Inspection program, Chemistry Control Program, Fluid Leak Management Program, Inspection Program for Civil Engineering Structures and Components, and Service Water Piping Corrosion Program are credited with managing the aging of several components in different structures and systems and are, therefore, considered as common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. The staff's evaluation of the Heat Exchanger Performance Testing Activities — Containment Spray Heat

Exchangers Program and the Heat Exchanger Preventive Maintenance Activities — Containment Spray Program follows.

Performance Testing Activities — Containment Spray Heat Exchangers

The applicant described its performance testing activities of the containment spray heat exchangers in Section B.3.17.2.1 of LRA Appendix B. The staff reviewed the LRA to determine whether the applicant had demonstrated that this program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The applicant stated that the purpose of the Performance Testing Activities — Containment Spray Heat Exchangers is to manage fouling of stainless steel and titanium heat exchanger tubes that are exposed to raw water. The Performance Testing Activities — Containment Spray Heat Exchangers is a performance monitoring program that monitors specific component parameters to detect the presence of fouling, which can affect the heat transfer function of the component.

The staff's evaluation of the Performance Testing Activities — Containment Spray Heat Exchangers program focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The scope of the Performance Testing Activities — Containment Spray Heat Exchangers includes the McGuire and Catawba containment spray heat exchanger tubes. The staff finds the scope to be appropriate because it includes the stainless steel and titanium heat exchanger tubes that are exposed to raw water and have the potential for fouling.

[Preventive or Mitigative Actions] The applicant stated that no actions are taken as part of this program to prevent aging effects or to mitigate aging degradation. The staff finds this acceptable and agrees with the applicant that the purpose of the performance testing activities is to detect, not prevent, tube fouling.

[Parameters Monitored or Inspected] The Performance Testing Activities — Containment Spray Heat Exchangers involve monitoring of heat transfer capability by performance of a heat capacity test. Based on a review of the program purpose and scope, the staff finds the parameters being monitored or inspected to be acceptable because they enable the applicant to identify tube fouling before the loss of component intended function.

[Detection of Aging Effects] The applicant stated that in accordance with the information provided under Monitoring and Trending, Performance Testing Activities — Containment Spray Heat Exchangers will detect fouling prior to loss of the component intended function. The staff agrees that the applicant is capable of identifying tube fouling prior to loss of intended function through performance testing.

[Monitoring and Trending] The applicant stated that Performance Testing Activities — Containment Spray Heat Exchangers involve calculation of a raw water fouling factor using tube and shell side inlet and outlet temperatures and flow rates. The applicant then uses the results of the fouling factor calculation to trend against a baseline value for indication of tube (heat transfer surface) cleanliness. The applicant stated that the procedures are performed on each of the containment spray heat exchangers annually at Catawba and every 3 years at McGuire. The applicant refers to information provided under operating experience as justification for the extended frequency at McGuire.

Based on the review of the monitoring and trending information provided in the application, the staff finds the monitoring and trending activities acceptable because they allow the applicant to identify fouling or degradation in a timely manner, given the type of inspections performed and the frequency.

[Acceptance Criteria] The applicant stated that the acceptance criteria of the Performance Testing Activities — Containment Spray Heat Exchangers are established by heat removal capacity calculations. The comparison of the calculated to the measured heat removal capacity must ensure that the heat exchangers are able to perform their design basis function. The staff's review found the acceptance criteria to be acceptable because it allows the applicant to identify tube fouling and take corrective action prior to loss of component function.

[Operating Experience] The applicant stated that operating experience has demonstrated that heat capacity tests provide adequate indication to predict when corrective action is required for heat transfer surface fouling. Corrective action in the form of tube cleaning, for example, is performed before the loss of the component intended function. Because the containment spray heat exchangers are used for emergency functions only, the applicant stated that placing the heat exchangers in wet lay-up several years ago has minimized buildup of fouling materials on the tubes. The applicant stated that the wet lay-up has proven so successful at McGuire that the frequency of heat capacity testing has been extended to a 3-year frequency. Experience has shown that a 3-year frequency allows for timely corrective action. Corrective action in the form of tube cleaning, for example, is performed before the heat transfer function of the heat exchanger tubes is degraded below its required capacity.

Based on the review of the applicant's operating experience with the performance testing activities, the staff finds that a basis exists for the extended interval between activities at McGuire. The staff also found that the operating experience demonstrates the effectiveness of the Performance Testing Activities — Containment Spray Heat Exchangers in identifying tube fouling before it can affect system performance.

FSAR Supplement: In LRA Appendix A-1, Section 18.2.13.2, for McGuire, and LRA Appendix A-2, Section 18.2.12.2, for Catawba, the applicant has provided proposed FSAR supplements summary descriptions of the program. The staff reviewed this information and found it to be consistent with the information provided in LRA Appendix B, Section B.3.17.2.1, and is therefore acceptable.

The staff reviewed the information in Section B.3.17.2.1 of LRA Appendix B. On the basis of its review and the above evaluation, the staff concludes that the applicant has demonstrated that the effects of aging associated with the Performance Testing Activities — Containment Spray Heat Exchangers program will be adequately managed, so that there is reasonable assurance that these components will perform their intended function(s) consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Heat Exchangers Preventive Maintenance Activities — Containment Spray

The applicant described its Heat Exchangers Preventive Maintenance Activities — Containment Spray in Section B.3.17.2.2 of LRA Appendix B. The staff reviewed the LRA to determine whether the applicant had demonstrated that this program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The applicant stated that the purpose of the Heat Exchangers Preventive Maintenance Activities — Containment Spray is to manage loss of material for parts of the containment spray heat exchanger exposed to raw water. The Heat Exchangers Preventive Maintenance Activities — Containment Spray is a condition monitoring program that monitors specific component parameters to detect the presence, and assess the extent, of material loss that can affect the pressure boundary function of the heat exchanger. The applicant credits this program with managing loss of material for stainless steel and titanium materials.

The staff's evaluation of the Heat Exchangers Preventive Maintenance Activities — Containment Spray program focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The applicant defined the scope of the Heat Exchangers Preventive Maintenance Activities — Containment Spray to include the McGuire and Catawba containment spray heat exchanger tubes. The applicant relies on other aging management programs, such as the Chemistry Control Program, to manage the aging effects of the heat exchanger shell, channel head, and tubesheets. The staff finds that the scope is appropriate for the described purpose, because it includes those major components in the containment spray system exposed to raw water.

[Preventive or Mitigative Actions] The applicant stated that no actions are taken as part of this program to prevent aging effects or to mitigate aging degradation. The staff agrees with the applicant because the purpose of the program is to detect and assess the extent of material loss, not to prevent such loss.

[Parameters Monitored or Inspected] The applicant stated that the Heat Exchangers Preventive Maintenance Activities — Containment Spray inspects the heat exchanger tubes to provide an indication of loss of material. The staff finds the parameters monitored to be acceptable, since the parameters evaluated and the methods used are comparable to industry practice and will result in detecting material loss before loss of component function.

[Detection of Aging Effects] The applicant stated that the Heat Exchangers Preventive Maintenance Activities — Containment Spray will be capable of detecting loss of material due to crevice, pitting, and microbiologically influenced corrosion prior to loss of the component intended functions. The inspections are performed periodically, and the program is capable of detecting and correcting aging degradation before loss of component function. Therefore, the staff finds this attribute acceptable.

[Monitoring and Trending] The applicant stated that the Heat Exchangers Preventive Maintenance Activities — Containment Spray performs eddy current testing on the heat exchanger tubes to measure wall thickness in order to detect areas with loss of material. At Catawba, NDT is performed on the perimeter tubes of each containment spray heat exchanger at least every 5 years. The applicant's program requires analysis following each NDT to determine the need for further testing, replacement, or repair. The applicant noted that the perimeter tubes comprise approximately 15 percent of the total tubes. At McGuire, NDT is performed on each heat exchanger as needed based on operating experience and engineering evaluation of test data. Based on the information provided in the application, the staff finds that because the monitoring is done at a regular frequency (Catawba) or based on operating experience and engineering judgment (McGuire), the program is capable of detecting and correcting aging degradation before loss of component function.

[Acceptance Criteria] The applicant stated that the acceptance criterion for the Heat Exchangers Preventive Maintenance Activities — Containment Spray is no loss of material of the tubes that could result in a loss of the component intended function, as determined by engineering judgment. The staff did not consider this an adequate acceptance criterion for the heat exchanger preventive maintenance activities AMP. The staff requested the applicant to specify parameters with quantitative limits. Because the same staff finding was identified for the Heat Exchanger Preventive Maintenance Activities — Pump Motor Air Handling Units, as documented in Section 3.0.3.9.1.2 of this SER, this was characterized as open item 3.0.3.9.1.2(c).

In its response to SER open item 3.0.3.9.1.2(b-g), dated October 28, 2002, the applicant indicated that eddy current testing is the method used to manage loss of material of the subject heat exchanger tubes. Eddy current testing is a standard industry practice used for detecting wall loss in heat exchangers, but requires careful engineering evaluation of all test results to provide the proper management of a heat exchanger. Steam generators are the only plant heat exchangers for which station technical specifications or sets of standards exist to define the flaw depth at which a tube must be plugged and removed from service.

For the low pressure, low temperature heat exchangers to which SER open items 3.0.3.9.1.2 (b-g) apply, evaluating eddy current test results for "unacceptable loss of material" involves many variables, such as tube material, characterization of the indication in terms of percent wall loss, rate of degradation as compared to previous indications, and the frequency of subsequent testing. Criteria such as ASME Code requirements, additional inspection results, and operating experience may be used to assess the severity of the degradation and the need for corrective actions.

The applicant further explained that eddy current testing at McGuire and Catawba is performed by a vendor who specializes in the practice. A 4-step process is used to determine if test results are acceptable and to generate the final test report. This process is described in detail in the applicant's October 28, 2002, response to this SER open item. The following is the process described by the applicant:

> (1) At the conclusion of testing of a component, the vendor's eddy current testing manager reviews the data and makes a plugging recommendation in the preliminary report based on his assessment of the damage flaws and experience with testing the component. Experience demonstrates that these specialists generally recommend evaluation at around a 70 percent wall loss range.
>
> (2) Duke then reviews the entire test data provided in the preliminary test report, including the recommendation for plugging, prior to returning the component to service. Duke evaluates the recommendations using all the information they have available. Particularly, Duke evaluates the rate of degradation based on the history of the tube. The wall loss may be deemed acceptable if the tube is showing minimal to no degradation from previous inspections. Consideration is also given to the frequency of the next inspection; if frequent inspection is performed, then a higher wall loss range may be acceptable and if less frequent inspection is performed then lower wall loss range may be unacceptable.
>
> (3) Depending on the type of tubing material and tubing damage detected with eddy current testing and possibly verified with actual tube pulled samples, a wall loss correlation may be determined as a threshold for evaluating the tube for plugging repair. Past operating experience with the type of tubing flaw may also be a very useful factor in determining the wall loss plugging threshold.
>
> (4) The loss of material experienced by these heat exchanger tubes generally manifests itself as pits. These pitting flaws are not very likely to fail heat exchanger tubing due to mechanical stress of pressure and temperature due to the shouldered nature or material reinforcement around pits. Therefore, the pitting rate as determined from past eddy current testing experience becomes the primary factor to consider when selecting tubes to remove from service to prevent later on-line tube leaks.

The applicant further stated that its experience in evaluating eddy current testing results has proven to be effective during the operation of McGuire and Catawba. Corrective actions such as tube plugging and tube bundle and heat exchanger replacement have been taken as a result of failed acceptance criteria of the subject programs. On the basis of the information provided in the applicant's October 28, 2002, open item response, the staff finds that appropriate and adequate acceptance criteria for detecting heat exchanger tube degradation from loss of material are identified for these aging management programs. Therefore, open items 3.0.3.9.1.2(b-g) are closed.

[Operating Experience] The applicant stated that operating experience associated with the Heat Exchangers Preventive Maintenance Activities — Containment Spray has demonstrated that the eddy current testing provides adequate information on the extent of wall loss present in the heat exchanger tubes to predict when corrective action is required. Corrective action in the form of tube plugging, for example, is performed by the applicant before the loss of the component intended function.

The applicant noted that some tube plugging has occurred, particularly early in service life. At Catawba, the applicant stated that the tube plugging rate has been essentially flat for the past several years due to operational improvements, including placing the heat exchangers in wet lay-up. The wet lay-up has proven so successful at McGuire that, according to the applicant, most recent test results indicate negligible tube wall degradation over several years. The staff agrees that because the monitoring methods are based on proven NDT techniques, and based on operating experience, the program is reliable to identify loss of material and take corrective action before loss of component function.

FSAR Supplement: In LRA Appendix A-1, Section 18.2.13.2, and LRA Appendix A-2, Section 18.2.12.2, the applicant has provided proposed FSAR supplements for McGuire and Catawba, respectively. The staff reviewed this information and found it to be consistent with the information provided in Appendix B, Section B.3.17.2.2 of the LRA and is therefore acceptable.

The staff reviewed the information in Section B.3.17.2.2, Appendix B of the LRA. On the basis of its review and the above evaluation, and with the resolution of SER open item 3.0.3.9.1.2(c), the staff concludes that the applicant has demonstrated that the effects of aging associated with the Heat Exchangers Preventive Maintenance Activities — Containment Spray program will be adequately managed, so that there is reasonable assurance that these components will perform their intended function(s) consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Based on its review of Table 3.2-4 and Appendix B of the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the CSS, and that there is reasonable assurance that the intended functions of the CSS will remain consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.4.3 Conclusions

The staff reviewed the information in Section 3.2, "Aging Management of Engineered Safety Features," of the LRA. The staff considered both industry and plant-specific experience. On the basis of its review, the staff concludes that the applicant's characterization of the aging effects associated with the CSS is consistent with published literature and industry experience. The staff further concludes that the applicant has appropriate aging management programs to effectively manage the aging effects of the CSS, and that there is reasonable assurance that the intended functions of the system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.5 Containment Valve Injection Water System

3.2.5.1 Technical Information in the Application

The McGuire Nuclear Station does not have containment valve injection water system. The Catawba Nuclear Station containment valve injection water system is designed to inject water between the two seating surfaces of double disc gate valves used for containment isolation. The injection pressure is higher than containment design peak pressure during a LOCA. This will prevent leakage of the containment atmosphere through the gate valves, thereby reducing potential offsite dose below the values specified by Title 10 CFR Part 100 limits following the postulated accident.

3.2.5.1.1 Aging Effects

Table 3.2-5 of the LRA identified the following components that will require aging management during the period of extended operation: pipe, tanks, tubing, and valve bodies. The material of construction for the above listed components is stainless steel. Loss of material and cracking were identified as applicable aging effects for the containment valve injection water system.

3.2.5.1.2 Aging Management Programs

The LRA identified that the Treated Water Systems Stainless Steel Inspection aging management program will manage the aging effects on the containment valve injection water system during the period of extended operation. A detailed description of the program is included in Appendix B of the LRA, along with the applicant's discussion of how the identified aging effects will be effectively managed for the period of extended operation.

3.2.5.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2 of the LRA. The purpose of the review was to ascertain whether the applicant has adequately demonstrated that the effects of aging for the containment valve injection water system will be adequately managed, so that the intended function of the systems will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.5.2.1 Aging Effects

The LRA included a summary of the results of the aging management review for the containment valve injection water system. The results are presented in Table 3.2-5 of the LRA. The materials of construction, internal/external environment, and aging effects for the containment valve injection water system are—

- stainless steel in sheltered/reactor building environment — no aging effects
- stainless steel in treated water environment — loss of material and cracking

Austenitic stainless steel materials are designed to be corrosion resistant in both dry or moist air environments. Therefore, cracking and corrosion generally have not been a problem for austenitic stainless steel components in sheltered air or reactor building air environments. The applicant, therefore, has not identified any applicable aging effects for the surfaces of stainless steel containment valve injection water system components exposed to these types of air environments.

Loss of material and cracking in stainless steel were identified as aging effects in a treated water environment. Loss of material and cracking of stainless steel in a treated water environment is a possible aging effect under certain conditions. Industry experience indicated that the presence of halogens in excess of 150 ppb and oxygen in excess of 100 ppb in stagnant or low flow conditions could lead to loss of material and cracking of stainless steel in a treated water environment. Therefore, the applicant will use the Treated Water Systems Stainless Steel Inspection program to manage the loss of material and cracking in a treated water environment.

The aging effects identified in LRA Table 3.2-5 are consistent with industry experience for the combinations of materials and environments listed. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.2.5.2.2 Aging Management Programs

The applicant identified that the Treated Water Systems Stainless Steel Inspection aging management program will be used to manage the aging effects associated with the containment valve injection water system. The Treated Water Systems Stainless Steel Inspection aging management program is credited with managing the aging of several components in different structures and systems and is, therefore, considered a common aging management program. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.2-5, the staff concludes that the above identified AMP will effectively manage the aging effects of the containment valve injection water system, and that there is reasonable assurance that the intended functions of the containment valve injection water system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.5.3 Conclusions

The staff reviewed the information in Section 3.2, "Aging Management of Engineered Safety Features," of the LRA. The staff considered both industry and plant-specific experience. On the basis of its review, the staff concludes that the applicant's characterization of the aging effects associated with the containment valve injection water system is consistent with published literature and industry experience. The staff further concludes that the applicant has appropriate aging management programs to effectively manage the aging effects of the containment valve injection water system, and that there is reasonable assurance that the intended functions of the system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.6 Refueling Water System

3.2.6.1 Technical Information in the Application

The McGuire refueling water system provides a source of borated water to be used during refueling, and for the emergency core cooling systems to mitigate the consequences of a UFSAR Chapter 15 accident. This system also provides borated makeup water for the spent fuel pool. The system can remove impurities from the refueling cavity and transfer canal during refueling, and it can clean the refueling water storage tank water following refueling. The refueling water system provides a means of transferring the final 30 percent of the refueling water between the refueling cavity and the refueling water storage tank. It also provides a secondary means of filling the refueling cavity from the refueling water storage tank. The Catawba refueling water system provides an adequate supply of borated water to the emergency core cooling system and containment spray system in order to mitigate the consequences of a design basis event. The refueling water system, along with the safety injection system, residual heat removal system, and CVCS function together to form the emergency core cooling system.

3.2.6.1.1 Aging Effects

Table 3.2-6 of the LRA identifies the following components that will require aging management: expansion joints, refueling water storage tanks, piping, tubing, and valve bodies. The applicant identified stainless and carbon steels as the materials of construction for the refueling water system components. Loss of material was identified as an applicable aging effect for carbon steel materials exposed to ventilation, yard, and borated water environments. Loss of material and cracking were identified as applicable aging effects for stainless steel materials exposed to an internal environment of borated water.

3.2.6.1.2 Aging Management Programs

The LRA identifies the following four aging management programs that will manage the aging effects of the refueling water system:

- Chemistry Control Program
- Borated Water Systems Stainless Steel Inspection
- Inspection Program for Civil Engineering Structures and Components
- Preventive Maintenance Activities — Refueling Water Storage Tank Internal Coating Inspection

Appendix B of the LRA contains a detailed description of those four aging management programs. The LRA cites these programs as methods to manage aging effects of the refueling water system components in applicable environments

3.2.6.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed Section 3.2 of the LRA. The purpose of the review was to determine whether the applicant will adequately manage the aging effects of the refueling water system while maintaining the current licensing basis of the system's intended function.

3.2.6.2.1 Aging Effects

The LRA includes a summary of the results of the aging management review for the refueling water system. The results are presented in table 3.2-6 of the LRA. The following list summarizes the materials of construction, the internal/external environments, and aging effects for the refueling water system:

- stainless steel in yard/ventilation/sheltered/reactor building environments — no aging effects
- stainless steel in borated water environment — loss of material and cracking
- carbon steel in ventilation environment — loss of material
- carbon steel in yard environments — loss of material
- carbon steel in borated water environment — loss of material

No aging effects were identified for expansion joints, piping, tubing, the refueling water storage tank, and valve bodies made of stainless steel in yard, sheltered, reactor building, or ventilation environments. Austenitic stainless steel materials are designed to be corrosion resistant in dry or moist air environments. Cracking and corrosion, therefore, generally have not been a problem for austenitic stainless steel components in these environments. The applicant, therefore, did not identify any applicable aging effects for the surfaces of stainless steel components exposed to the above identified environments.

The applicant identified loss of material and cracking as aging effects on stainless steel in the borated water environment. Loss of material and cracking of stainless steel in this environment are possible aging effects under certain conditions. Industry experience indicates that the presence of halogens in excess of 150 ppb, oxygen in excess of 100 pbb, and temperature in excess of 200 °F in stagnant or low flow conditions can lead to loss of material and cracking. Therefore, the applicant will use the Chemistry Control Program and the Borated Water Systems Stainless Steel Inspection program to manage the loss of material and cracking in the borated water environment.

The applicant identified loss of material as an aging effect on the carbon steel refueling water storage tank in a ventilation and yard environment. Loss of material of carbon steel materials by corrosion may occur in moist air environments and, therefore, may be an applicable aging effect. In addition, borated water leaks from other plant systems may also cause loss of material of carbon steel components. The applicant will use the Preventive Maintenance Activities — Refueling Water Storage Tank Internal Coating Inspection and the Inspection Program for Civil Engineering Structures and Components to manage the loss of material associated with the carbon steel refueling water storage tank.

The applicant identified loss of material as an aging effect on the carbon steel refueling water storage tank in the borated water environment. Loss of material of carbon steel materials by boric acid corrosion may occur in borated water environments and, therefore, may be an applicable aging effect. The applicant will use the Preventive Maintenance Activities — Refueling Water Storage Tank Internal Coating Inspection to manage the loss of material associated with the carbon steel refueling water storage tank.

The aging effects identified in LRA Table 3.2-6 are consistent with industry experience for the combinations of materials and environments listed. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.2.6.2.2 Aging Management Programs

The applicant identified the following four aging management programs that will manage the aging effects of the refueling water system:

- Chemistry Control Program
- Borated Water Systems Stainless Steel Inspection Program
- Inspection Program for Civil Engineering Structures and Components
- Preventive Maintenance Activities — Refueling Water Storage Tank Internal Coating Inspection Program

The Chemistry Control Program, Borated Water Systems Stainless Steel Inspection program, and Inspection Program for Civil Engineering Structures and Components, are credited with managing the aging of several components in different structures and systems and are, therefore, considered as common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. The staff's evaluation of the Preventive Maintenance Activities — Refueling Water Storage Tank Internal Coating Inspection program follows:

Preventive Maintenance Activities — Refueling Water Storage Tank Internal Coating Inspection

The applicant developed the Preventive Maintenance Activities — Refueling Water Storage Tank Internal Coating Inspection program to manage the potential aging of the carbon steel refueling water storage tanks at McGuire. The internal surfaces of the carbon steel tanks are coated with a phenolic epoxy coating to prevent borated water and air from contacting the internal surfaces. This program manages loss of material of the tanks by managing the condition of the internal coating. This program is only applicable to McGuire.

In Section B.3.24 of LRA Appendix B, the applicant described the Preventive Maintenance Activities — Refueling Water Storage Tank Internal Coating Inspection program. The purpose of the program is to manage loss of material of the internal surfaces of the carbon steel refueling water storage tanks. The internal carbon steel surfaces of the refueling water storage tank are coated with a phenolic epoxy paint that prevents borated water and air from contacting the internal surfaces. Continued presence of an intact coating precludes loss of material that could lead to loss of pressure boundary function. This preventive maintenance activity inspects the internal coating of the refueling water storage tanks to check the condition of the coating and to identify coating failures. This program is only applicable to McGuire.

The staff's evaluation of the Preventive Maintenance Activities — Refueling Water Storage Tank Internal Coating Inspection program focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The LRA indicates that the corrective actions and confirmation process are implemented through the site corrective actions process, while the administrative controls are implemented through the site procedures and work processes. The staff's evaluation of the corrective actions, confirmation process, and administrative controls is provided in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The applicant defined the scope of the Preventive Maintenance Activities — Refueling Water Storage Tank Internal Coating Inspection program as the internal surface of the McGuire carbon steel refueling water storage tanks. The comparable refueling water storage tanks at Catawba are constructed of stainless steel and are managed by the Borated Water Systems Stainless Steel Inspection (Section B.3.4 of LRA Appendix B) and the Chemistry Control Program (Section B.3.6 of LRA Appendix B).

The staff finds the scope of this aging management program to be acceptable because it includes the tanks that may be subject to coating failure. Limiting the inspection to the refueling water storage tanks at McGuire is acceptable because the corresponding tanks at Catawba are constructed of different materials and are covered by other programs.

[Preventive or Mitigative Actions] The applicant indicated that no actions are taken as part of this program to prevent aging effects or to mitigate aging degradation. The staff agrees that the inspection program is intended to identify potential problems, such that corrective action may be taken prior to loss of component function, and that there is no need for preventive actions.

[Parameters Monitored or Inspected] The program inspects the phenolic epoxy paint for signs of blistering, chipping, peeling, and missing paint, as well as signs of corrosion of the underlying carbon steel tank. The staff finds the parameters inspected to be acceptable since the inspections are capable of identifying signs of coating damage or deterioration, such that corrective actions can be taken prior to loss of component function.

[Detection of Aging Effects] The program uses visual inspection to identify blistering, chipping, peeling, and missing paint, as well as signs of corrosion of the underlying carbon steel tank. The staff concludes that these inspections are capable of identifying loss of integrity of the coating and loss of material of the tank prior to loss of the component intended function.

[Monitoring and Trending] Section B.3.24.2 of LRA Appendix B states that the refueling water storage tank's internal phenolic epoxy paint will be visually inspected every 10 years using an underwater video camera. The inspection looks for signs of blistering, chipping, peeling, and missing paint, as well as signs of corrosion of the underlying carbon steel tank. Detection of defects in the internal coating results in draining of the tank for further inspection and evaluation of the defects. No actions are taken as part of this activity to trend inspection results.

The staff finds that the monitoring is appropriate for the scope of this inspection. Since the coating is in an area where radiation and thermal conditions are low, and degradation of the coating, is a slow process, the 10-year frequency is acceptable. The staff finds that the inspection will provide an indication of the condition of the tank coating and is based on methods that are common in the industry. The staff concurs that trending is not required since the inspection frequency is not conducive to trending.

[Acceptance Criteria] The applicant described the acceptance criteria as "no visual indications of coating defects" that have led to corrosion of the underlying carbon steel tank surfaces. The staff agrees that because the visual inspections are capable of detecting degradation of the coating surfaces, and the approach is consistent with industry practices, the acceptance criteria are acceptable.

[Operating Experience] The applicant stated that the internal surfaces of the refueling water storage tanks for McGuire were inspected during recent outages using an underwater camera. The inspection revealed some second coating blistering. The applicant drained the tanks, visually inspected, and repainted in the necessary locations. The applicant stated that no bare metal was exposed as a result of the blistering because a layer of coating remained in the blistered location. The applicant observed during these inspections that the submerged portion of the tanks showed little to no degradation. However, the roof, which is not a part of the pressure boundary of the tank, did show evidence of coating concerns and was blasted and repainted in several locations.

The staff finds that the operating experience with program indicates that the activities will be effective in managing loss of material of the tanks by maintaining the effectiveness of the internal coatings. Because of the effectiveness of the inspections, as noted in the operating experience, the staff concludes that the program can reasonably be expected to maintain the tank integrity through the period of extended operation.

FSAR Supplement: In LRA Appendix A-1, Section 18.2.20.2, the applicant provided a proposed new UFSAR section for McGuire. The staff reviewed this material and found it to be consistent with the material provided in Appendix B. Therefore, it is acceptable.

In conclusion, the staff reviewed the information provided in Section B.3.24.2 of LRA Appendix B and the summary description in the FSAR supplement in Appendix A of the LRA. On the basis of this review and the above evaluation, the staff finds that there is reasonable assurance that the aging effect of loss of material of the McGuire refueling water storage tanks will be adequately managed, such that the intended function will be maintained during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Based on its review of Table 3.2-5 and Appendix B of the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the refueling water system, and that there is reasonable assurance that the intended functions of the refueling water system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.6.3 Conclusions

The staff reviewed the information in Section 3.2, "Aging Management of Engineered Safety Features," of the LRA. The staff considered both industry and plant-specific experience. On the basis of its review, the staff concludes that the applicant's characterization of the aging effects associated with the refueling water system is consistent with published literature and industry experience. The staff further concludes that the applicant has appropriate aging management programs to effectively manage the aging effects of the refueling water system, and that there is reasonable assurance that the intended functions of the system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.7 Residual Heat Removal System

3.2.7.1 Technical Information in the Application

The applicant described its AMR for the residual heat removal (RHR) system in Section 3.2 of the LRA. The RHR system transfers heat from the RCS to the component cooling system to reduce the temperature of the reactor coolant to the cold shutdown temperature at a controlled rate during the second part of unit cooldown, and maintains this temperature until the unit is started up. The RHR system also serves as part of the emergency core cooling system during the injection and recirculation phases of small-break and large-break loss of coolant accidents. The McGuire and Catawba UFSARs, Section 6.3, Emergency Core Cooling System, provide additional information concerning the RHR system. The mechanical components, component functions, and materials of construction for the RHR system are listed in Table 3.2-7.

3.2.7.1.1 Aging Effects

In Table 3.2-7 of the application, the applicant identifies the following components that are subject to an AMR: heat exchangers and their subcomponents, piping, orifices, tubing, pump casings, and valve bodies. In this table, the applicant identifies that these components are fabricated from stainless steel materials, with the exception of the RHR heat exchanger shells and RHR pump seal water shells, which are fabricated from carbon steel.

Loss of material was identified as an applicable aging effect for carbon steel materials exposed to treated water and sheltered environments. Loss of material and cracking were identified as applicable aging effects for stainless steel materials exposed to borated and treated water environments and for carbon steel materials exposed to a treated water environment.

3.2.7.1.2 Aging Management Programs

The applicant credits the following programs and activities for managing the aging effects attributed for the RHR components:

- Chemistry Control Program
- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components

The applicant stated that it will use the Fluid Leak Management Program (Section B.3.15 of LRA Appendix B) and the Inspection Program for Civil Engineering Structures and Components (Section B.3.21 of LRA Appendix B) to manage loss of material in carbon steel RHR components exposed to sheltered air environments. The applicant also stated that it will use the Chemistry Control Program (Section B.3.6 of LRA Appendix B) to manage loss of material and cracking in stainless steel RHR components that are exposed to borated or treated water environments, and loss of material and cracking in carbon steel components that are exposed to treated water environments.

3.2.7.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2 (including Table 3.2-7), and pertinent sections of LRA Appendices A and B, to ascertain that the effects of aging will be adequately managed, so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.7.2.1 Aging Effects

Table 3.2-7 of the application identifies which of these aging effects are applicable to the specific RHR components identified in the table as being within the scope of license renewal. Specifically, Table 3.2-7 identifies that the following aging effects are applicable to the material-environment combinations for the RHR components:

- stainless steel components exposed to borated or treated water environments — loss of material and cracking
- stainless steel components in contact with sheltered or reactor building environments — no

aging effects identified

- carbon steel components exposed to sheltered environments — loss of material
- carbon steel RHR pump seal water components exposed to treated water environments — loss of material
- carbon steel RHR heat exchanger components exposed to treated water environments — loss of material and cracking

Industry experience and experimental data have demonstrated that austenitic stainless steel materials may be susceptible to stress corrosion cracking or loss of material (as a result of pitting or general corrosion) when exposed to borated water solutions. Elevated levels of oxidizing impurity species (i.e., oxygen, sulfates, halides, etc.) increase the potential for these aging effects to occur. These aging effects are therefore applicable to the stainless steel RHR components in contact with borated water solutions. The applicant has appropriately identified these aging effects as being applicable to stainless steel RHR components whose internal surfaces are exposed to borated water. This determination is acceptable to the staff.

Austenitic stainless steel materials are designed to be corrosion resistant in both dry or moist air environments. Therefore, cracking and corrosion generally have not been a problem for austenitic stainless steel components in sheltered or reactor building environments. Therefore, the applicant has not identified any applicable aging effects for the surfaces of stainless steel RHR components exposed to these types of air environments. Based on these considerations, the staff finds the applicant's identification of the aging effects for stainless steel RHR components to be acceptable.

Use of raw, untreated water in heat exchanger tubes may be prone to biological fouling that could impede the heat exchange functions of the tubes over time. However, raw, untreated water is not the cooling medium for the tubing, the annulus regions of the RHR heat exchangers, or the RHR pump seal water heat exchangers. Therefore, the applicant has not identified fouling as an applicable effect for these heat exchangers. The carbon steel RHR heat exchanger shells are in contact with sheltered air environments on their external surfaces, and treated water on their internal surfaces. The internal surfaces of the shell may be subject to loss of material through general corrosion (rusting) when exposed to wet environments. The applicant has also identified cracking as an additional aging effect that requires management for the internal surfaces of the RHR heat exchanger shells.

By letter dated January 23, 2002, the staff informed the applicant that the internal surfaces of the carbon steel residual RHR heat exchanger shells and RHR pump seal water heat exchanger shells are both exposed to treated water environments, and requested, in RAI 3.2-4, the applicant to clarify, either by reference to appropriate information in the application or by discussion, why cracking is identified as an applicable aging effect for the RHR heat exchanger shells but not for the RHR pump seal water heat exchanger shells. In its response dated April 15, 2002, the applicant stated that cracking should have been also identified for the internal surfaces of the RHR pump seal water heat exchangers shells, and that the Chemistry Control Program is credited as the aging management program for managing the cracking. The applicant submitted a revised Table 3.2-7 AMR for the RHR pump seal water heat exchangers shells to replace the corresponding entry in the LRA. The applicant's resolution of RAI 3.2-4 is, therefore, acceptable to the staff.

Further, the external surfaces of these components may be subject to corrosion if leaks develop. Therefore, the applicant has appropriately identified that loss of material is an applicable aging effect for the surfaces of the RHR heat exchangers and ND pump seal water heat exchangers shells that are exposed to treated water and sheltered air environments. This determination is acceptable to the staff.

The aging effects identified in LRA Table 3.2-7 are consistent with industry experience for the combinations of materials and environments listed. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.2.7.2.2 Aging Management Programs

Table 3.2-7 of the LRA states that the following programs and activities are credited for managing the aging effects attributed to the RHR components:

- Chemistry Control Program
- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components

The Chemistry Control Program, Fluid Leak Management Program, and Inspection Program for Civil Engineering Structures and Components are credited with managing the aging of several components in different structures and systems and are, therefore, considered as common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.2-7, the staff concludes that the above identified AMPs will effectively manage the aging effects of the RHR system, and that there is reasonable assurance that the intended functions of the RHR system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.7.3 Conclusions

The staff reviewed the information in Section 3.2, "Aging Management of Engineered Safety Features," of the LRA. The staff considered both industry and plant-specific experience. On the basis of its review, the staff concludes that the applicant's characterization of the aging effects associated with the RHR is consistent with published literature and industry experience. The staff further concludes that the applicant has appropriate aging management programs to effectively manage the aging effects of the RHR, and that there is reasonable assurance that the intended functions of the system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.8 Safety Injection System

3.2.8.1 Technical Information in the Application

The applicant described its AMR for the safety injection system (SIS) in Section 3.2 of the LRA. The SIS constitutes a major portion of the ECCS. Along with the residual heat removal, chemical and volume control, and refueling water systems, the SIS provides emergency cooling water to the reactor core in the event of a break in either the primary (reactor coolant) or secondary (steam) systems. The three primary functions of the ECCS are (1) to remove stored (sensible) and fission product decay heat, (2) to control reactivity, and (3) to preclude reactor vessel boron precipitation. The SIS supports each of these functions. Section 6.3, "Emergency Core Cooling System," of the McGuire and Catawba UFSARs provides additional information concerning the SIS. The mechanical components, component functions, and materials of construction for the SIS are listed in Table 3.2-8 of the LRA.

3.2.8.1.1 Aging Effects

In Table 3.2-8 of the LRA, the applicant identifies the following components that are subject to an AMR: pump casings, piping, orifices, accumulators, tubing, and valve bodies. In the table, the applicant identifies that all of these components are fabricated from stainless steel materials, with the following exceptions:

- A small portion of SIS pipe is fabricated from carbon steel.
- SIS accumulators are fabricated from carbon steel with an internal stainless steel cladding.
- Some SIS valve bodies are fabricated from carbon steel.

Loss of material was identified as an applicable aging effect for carbon steel materials exposed to the reactor building and sheltered external environments. Loss of material and cracking were identified as applicable aging effects for stainless steel materials exposed to a borated water environment.

3.2.8.1.2 Aging Management Programs

The applicant credits the following programs and activities for managing the aging effects attributed for the SIS components:

- Chemistry Control Program
- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components

The applicant stated that it will use the Fluid Leak Management Program (Section B.3.15 of LRA Appendix B) and the Inspection Program for Civil Engineering Structures and Components (Section B.3.21 of LRA Appendix B) to manage loss of material in carbon steel SIS components exposed to sheltered air and reactor building environments. The applicant also stated that it will use the Chemistry Control Program (Section B.3.6 of LRA Appendix B) to manage loss of material and cracking in stainless steel SIS components that are exposed to treated water environments.

3.2.8.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2 (including Table 3.2-8), and pertinent sections of Appendices A and B to the LRA, to ascertain that the effects of aging will be adequately managed, so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.8.2.1 Aging Effects

The LRA includes a summary of the results of the AMR for the SIS system. The results are presented in table 3.2-8 of the LRA. The following list summarizes the materials of construction, the internal/external environments, and aging effects for the SIS:

- stainless steel components exposed to borated water environments — loss of material and cracking
- carbon steel components whose external surfaces are exposed to reactor building and sheltered environments — loss of material

Industry experience and experimental data have demonstrated that austenitic stainless steel materials may be susceptible to stress corrosion cracking or loss of material (as a result of pitting or general corrosion) when exposed to borated water. Elevated levels of oxidizing impurity species (i.e., oxygen, sulfates, halides, etc.) increase the potential for these aging effects to occur. These aging effects are therefore applicable to the stainless steel SIS components in contact with borated water solutions. The applicant has appropriately identified these aging effects as being applicable to stainless steel SIS components whose internal surfaces are exposed to borated water. This determination is acceptable to the staff.

Austenitic stainless steel materials are designed to be corrosion resistant in both dry or moist air environments. Therefore, cracking and corrosion generally have not been a problem for austenitic stainless steel components in air-gas, sheltered, or reactor building environments. The applicant, therefore, has not identified any applicable aging effects for internal surfaces of stainless steel SIS components exposed to an air-gas environment, or the external surfaces of stainless steel SIS components exposed to sheltered air or reactor building air environments. Based on these considerations, the staff finds the applicant's identification of the aging effects for stainless steel SIS components to be acceptable.

The carbon steel SIS piping and valve body components are in contact with air-gas environments on their internal surfaces, and either sheltered air or reactor building environments on their external surfaces. Carbon steels may be prone to loss of material by corrosion when exposed to moist air environments. Therefore, loss of material may be an applicable aging effect for the surfaces of carbon steel SIS components that are exposed to sheltered or reactor building air environments.

By letter dated January 28, 2002, the staff asked, in RAI 3.2-5, the applicant to clarify, either by reference to appropriate information in the application or by discussion, why loss of material is identified as an applicable aging effect for the carbon steel SIS piping that is exposed sheltered air, but not for the carbon steel SIS valve bodies that are exposed to the same environment. In its response, dated May 15, 2002, the applicant stated that the aging effects for carbon steel valve bodies exposed to sheltered air environments should be identical to those for carbon steel piping exposed to the same environment and that, therefore, loss of material should have been identified for the carbon steel valve bodies exposed externally to sheltered air environments. The applicant provided an amended entry for the SIS carbon steel valve bodies exposed internally to the air-gas environment and externally to the sheltered air environment that is consistent with the corresponding entry for carbon steel piping in Table 3.2-8 of the application. This is acceptable to the staff and resolves the staff's issue identified in RAI 3.2-5.

The carbon steel surfaces of the accumulators may be prone to loss of material by corrosion if borated water leaks onto the external surfaces of the accumulators. The applicant has appropriately accounted for this as an additional mechanism that can result in loss of material for the carbon steel surfaces of the accumulators. The applicant has not identified any applicable aging effects for the surfaces of carbon steel SIS components that are exposed to air-gas environments. The air-gas environments are compressed dry gaseous environments. Loss of material and cracking generally have not been a problem for carbon steel surfaces that are exposed to air-gas environments. Based on the considerations discussed in this section, the staff considers the applicant's aging effect analysis for the carbon steel SIS components to be acceptable.

The aging effects identified in LRA Table 3.2-8 are consistent with industry experience for the combinations of materials and environments listed. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.2.8.2.2 Aging Management Programs

Table 3.2-8 of the LRA states that the following aging management programs are credited for managing the aging effects attributed to the SIS components:

- Chemistry Control Program
- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components

The Chemistry Control Program, Fluid Leak Management Program, and Inspection Program for Civil Engineering Structures and Components are credited with managing the aging of several components in different structures and systems and are, therefore, considered as common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.2-8, the staff concludes that the above identified AMPs will effectively manage the aging effects of the SIS, and that there is reasonable assurance that the intended functions of the SIS will remain consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.8.3 Conclusions

The staff reviewed the information in Section 3.2, "Aging Management of Engineered Safety Features," of the LRA. The staff considered both industry and plant-specific experience. On the basis of its review, the staff concludes that the applicant's characterization of the aging effects associated with the SIS is consistent with published literature and industry experience. The staff further concludes that the applicant has appropriate aging management programs to effectively manage the aging effects of the SIS, and that there is reasonable assurance that the intended functions of the system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.9 Containment Air Return Exchange and Hydrogen Skimmer Systems — Supplemental Evaluation

In a letter dated January 23, 2002, the staff requested, in RAI 2.3.2.3-2, the applicant to indicate whether or not the McGuire and Catawba containment hydrogen analyzers and their subcomponents should be included within the scope of license renewal. In its response to RAI 2.3.2.3-2, dated April 15, 2002, the applicant concurred with the staff that the passive mechanical components for the McGuire and Catawba hydrogen analyzers associated with the hydrogen skimmer systems should be within the scope of license renewal. This section documents the staff's evaluation of the AMR results that were provided for the additional components brought into the scope of license renewal as a result of this RAI.

3.2.9.1 Technical Information in the Application

The containment air return exchange and hydrogen skimmer systems provide the following safety-related functions for the McGuire and Catawba nuclear plants: (1) maintain containment pressure less than the design pressure during any high energy line break (HELB), (2) ensure hydrogen concentration remains less than the flammability limit during a loss-of-coolant-accident (LOCA), and (3) maintain containment isolation integrity for the system piping penetrating the containment. McGuire and Catawba UFSAR Sections 6.2, Containment Systems, provide additional information concerning the McGuire and Catawba containment air return exchange and hydrogen skimmer systems. The mechanical components, component functions, and materials of construction for the McGuire containment air return exchange and hydrogen skimmer systems are listed in Table 3.2-3 of the LRA.

3.2.9.1.1 Aging Effects

In the Table attached to its response to RAI 2.3.2.3-2, the applicant stated that the major flowpaths for the McGuire and Catawba hydrogen analyzers include the following components that are subject to AMRs: tubing and valve bodies for McGuire and Catawba (and McGuire-specific piping). In this table, the applicant identifies that all of these components are fabricated from stainless steel materials. The applicant identifies that these components are subject to any of the following environments:

- ventilation air
- sheltered air
- reactor building air

The applicant did not identify any additional aging affects associated with the passive mechanical hydrogen analyzer components brought within the scope of license renewal.

3.2.9.1.2 Aging Management Programs

The applicant did not identify any aging management programs necessary for the passive mechanical hydrogen analyzer components brought within the scope of license renewal.

3.2.9.2 Staff Evaluation

3.2.9.2.1 Aging Effects

As summarized in the application, the applicant stated the sheltered and reactor building environments are moist air environments; however, during normal system operations of the systems, any components whose external surface temperatures are the same as or higher than the ambient temperature conditions for these environments are expected to be dry. The applicant states that the ventilation air environment is ambient air that is conditioned to maintain a suitable environment for equipment operation and personnel occupancy.

Since the internal and external environmental surface conditions for these components should be under either dry or controlled air conditions, the staff concurs that no aging effects are applicable for the stainless steel tubing and valves (and for McGuire, the McGuire-specific stainless steel piping) associated with the hydrogen analyzers.

3.2.9.2.2 Aging Management Programs

Since the environmental surface conditions for these components should be under either dry or controlled air conditions, and no aging effects are applicable for the stainless steel tubing and valves (and for McGuire, the McGuire-specific stainless steel piping) associated with the hydrogen analyzers, the staff concurs that no aging management programs are necessary for the passive mechanical hydrogen analyzer components within the scope of license renewal.

3.2.9.3 Conclusions

The staff reviewed the information in Section 3.2 of the LRA and the table attached to the applicant's response to RAI 2.3.2.3-2, dated April 15, 2002, as the information pertains to the AMRs for the additional hydrogen analyzers components brought within the scope of license renewal. On the basis of its review, the staff concludes that the applicant has demonstrated that there are not any aging effects associated with the additional hydrogen analyzers components brought within the scope of license renewal, and that the hydrogen analyzer components brought within the scope of license renewal need not be managed to provide reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.10 Aging Management Review for Closure Bolting in Engineered Safety Features

Although the LRA provided AMR results for Class 1 bolting, it did not address bolting for non-Class 1 components. By letter dated January 23, 2002, the staff requested, in RAI 3.2-1, additional information that pertains to tables in Sections 3.2, 3.3, and 3.4 of the LRA that list closure bolting as components subject to an AMR. The staff stated that since closure bolting is exposed to air, moisture, and leaking fluid (boric acid) environments, it is subject to the aging effect of loss of material and crack initiation and growth. Tables in Sections 3.2, 3.3 and 3.4 of the LRA do not address these aging effects for closure bolting in these systems. The staff requested the applicant to identify the AMR results for closure bolting, or to provide a justification for excluding closure bolting from an AMR, the results of which are documented in the referenced tables of the LRA.

3.2.10.1 Aging Effects

The applicant indicated that non-Class 1 mechanical components within the scope of license renewal contain bolted closures that are necessary for the pressure boundary of the component. Examples of these bolted closures are valve bonnet to body closures, pump cover to casing closures, heat exchanger manway and end-bell closures, and piping flange sets. The bolted closure is comprised of two mating surfaces, a gasket, and a fastener set of studs or bolts and nuts. By themselves, the mating set, gasket, and fastener set have no component intended function. Together, the bolted closure forms an integral part of the pressure retaining boundary of the component. Gaskets are not relied upon for pressure boundary of the bolted closure in accordance with the design codes and, therefore, are not subject to an aging management review.

Bolted closures are exposed to two environments. The mating surfaces are exposed internally to the process fluid, while the external surfaces and the fastener set are exposed to the ambient environment where the bolted closures are located. Aging effects for external and internal surfaces of the mating set of bolted closures are the same as other components in the system that are of the same material and exposed to the same environment. Programs for the system (i.e., Chemistry Control Program and Fluid Leak Management Program) containing the bolted closure are applicable to the mating set and are not discussed here further.

The aging effects for the fastener set of non-Class 1 bolted closures are loss of material of carbon and low-alloy steel, and cracking of carbon, low-alloy, and stainless steels. Loss of material of the fastener set of the bolted closure may occur as a result of fluid leakage, use of an improper lubricant during assembly, or exposure to the ambient environment. Cracking of the fastener set of bolted closures may occur as a result of improper material selection, improper torquing during assembly, use of an improper lubricant, fluid leakage, or exposure to the ambient environment. Of these aging effects, Duke determined the following are the aging effects requiring management for carbon and low-alloy steel fastener sets:

- loss of material of the fastener set due to boric acid exposure
- loss of material of the fastener set in systems with operating temperatures below ambient conditions that result in condensation
- loss of material of the fastener set in the yard environment that are repeatedly wetted and dried from exposure to the elements

The applicant stated that no aging effects requiring management were identified for the stainless steel fastener set of bolted closures.

On the basis of its review of the RAI response pertaining to non-Class 1 bolting, the staff finds that all applicable aging effects were identified, and the aging effects identified are appropriate for the combination of materials and environments identified.

3.2.10.2 Aging Management Programs

The applicant identified the following two aging management programs that will manage the aging effects of closure bolting:

- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components

The applicant indicated that the Fluid Leak Management Program will manage loss of material of non-Class 1 bolted closures in the reactor and auxiliary buildings due to leakage from systems containing boric acid. No systems containing boric acid are located outside these two buildings. The Fluid Leak Management Program is described in Appendix B, Section B.3.15 of the LRA for McGuire and Catawba.

The Inspection Program for Civil Engineering Structures and Components will manage loss of material of non-Class 1 bolted closures in systems with operating temperatures below the surrounding ambient environment that are wet with condensation. In addition, this program will also manage loss of material of non-Class 1 bolted closures located in the yard that are repeatedly wetted and dried from exposure to the elements. The Inspection Program for Civil Engineering Structures and Components is described in Appendix B, Section B.3.21 of the LRA for McGuire and Catawba.

The Fluid Leak Management Program and the Inspection Program for Civil Engineering Structures are considered common AMPs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for non-Class 1 closure bolting. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

3.2.10.3 Conclusions

Based on the above discussion, the staff finds that the applicant's response clarifies and satisfactorily resolves this issue concerning the closure bolting in mechanical systems as described in RAI 3.2-1. The staff concludes that the applicant has demonstrated that the aging effects associated with non-Class 1 bolting will be adequately managed, so there is reasonable assurance that these components will perform their intended functions consistent with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3 Auxiliary Systems

The applicant described its AMR of the Auxiliary Systems in Section 2.3.3, "Auxiliary Systems," and in Section 3.3, "Aging Management of Auxiliary Systems." Appendices A and B to the LRA also contain supplementary information related to the AMR of the auxiliary systems. The staff reviewed this section of the application in accordance with Chapter 3 of the Standard Review Plan for License Renewal (NUREG-1800) to determine whether the applicant provided adequate information to meet the requirements of 10 CFR Part 54 for managing the aging effects of the Auxiliary Systems for license renewal.

In LRA Section 2.1, "Scoping and Screening Methodology," the applicant described the method used to identify the structures and components (SCs) that are within the scope of license renewal and subject to an AMR. The applicant identified and listed the structures in LRA Section 2.4, "Scoping and Screening Results: Structures." The staff's evaluation of the scoping methodology and the structures included within the scope of license renewal, and subject to an AMR, is documented in Sections 2.1 and 2.4 of this SER, respectively.

Section 3.3 of the LRA defined the external and internal environments applicable to the auxiliary systems as follows—

- Air-Gas — Compressed air is ambient air that has been filtered and compressed for use in plant equipment. Compressed air may be either dry or oiled. Compressed gasses include carbon dioxide, hydrogen, nitrogen, freon, or refrigeration gasses used to replace freon due to environmental concerns.
- Borated Water — Borated water is demineralized water treated with boric acid.
- Embedded Environment — A component encased in concrete is in an embedded environment. The concrete forms a tight seal around the external surfaces of the component.
- Oil and Fuel Oil — Lubricating oil is an organic fluid used to reduce friction between moving parts. Fuel oil is the fuel used for the emergency diesel generators.
- Raw Water — Raw water is water from a lake, pond, or river that has been rough-filtered and possibly treated with a biocide.
- Reactor Building — The Reactor Building environment is moist air. Components in systems with external surface temperatures the same or higher than ambient conditions due to normal system operation are expected to be dry.
- Sheltered environment — The ambient conditions within the sheltered environment may or may not be controlled. The sheltered environment atmosphere is a moist air environment. Components in systems with external surface temperatures the same or higher than ambient conditions due to normal system operation are expected to be dry.
- Treated water — Treated water is demineralized water that may be deareated, treated with a biocide or corrosion inhibitors, or a combination of these treatments. Treated water does not include borated water, which is evaluated separately.
- Underground Environment — Components in an underground environment are in contact with soil and possibly groundwater. Components located underground are normally coated and wrapped to prevent the soil and groundwater from contacting the surface of the component.
- Ventilation — Ambient air that is conditioned to maintain a suitable environment for equipment operation and personnel occupancy.

- Yard — Yard environment is a moist air environment in which equipment is exposed to heat, cold, and precipitation.

In Appendix A of the LRA, "Updated Final Safety Analysis Report (UFSAR) Supplement," the applicant provided a summary description of the programs and activities used to manage the effects of aging, as required in 10 CFR 54.21(d). The applicant provided a more detailed description of these AMPs for the staff to use in its evaluation in Appendix B to the LRA. In LRA Appendix D, the applicant states that no changes to the McGuire and Catawba Technical Specifications (TS) have been identified. A discussion of the AMR results for each system follows.

3.3.1 Auxiliary Building Ventilation System

3.3.1.1 Technical Information in the Application

The auxiliary building ventilation system is essentially the same, and performs the same function, for McGuire and Catawba. The auxiliary building ventilation system automatically aligns to maintain the ECCS pump rooms at a negative pressure, so that air exhausted from these rooms is filtered prior to being released following a design basis accident (DBA). The ECCS pump rooms include safety injection pumps, residual heat removal pumps, centrifugal charging pumps, and containment spray pumps. The McGuire and Catawba UFSARs provide more detailed descriptions in Sections 9.4.2 and 9.4.3, respectively.

3.3.1.1.1 Aging Effects

Components of the auxiliary building ventilation system are described in Section 2.3.3.1 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-1, pages 3.3-6 through 3.3-10, lists individual components of the system, including the air flow monitors, air handling units, ductwork, filters, demisters, condensers, area heaters, tubing, and valve bodies. Stainless steel components are identified as being subject to ventilation and sheltered environments, and are subject to no aging effects. Carbon steel components are subject to the aging effect of loss of material from internal and external surfaces from sheltered and treated water environments. Carbon steel components are also subject to the aging effect of cracking from exposure to a treated water environment. Carbon steel components are also exposed to a gas (Freon-22) environment with no aging effects. Galvanized steel components are identified as being subject to the aging effect of loss of material from the sheltered environment. Copper components are subject to the aging effect of loss of material and fouling from internal surfaces from raw water environments, and external surfaces from loss of material from exposure to sheltered environments. Copper components also are exposed to a ventilation environment with no aging effects. Copper-nickel components are subject to the aging effect of loss of material and fouling from internal surfaces from treated water environments. Copper-nickel components are also exposed to a gas (Freon-22) environment with no aging effects. Brass components are subject to the aging effect of loss of material to external surfaces from sheltered environments. No aging effects are identified to brass components subjected to a ventilation environment.

3.3.1.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the auxiliary building ventilation system:

- Fluid Leak Management Program
- Heat Exchanger Preventive Maintenance Activities — Pump Motor Handling Units
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the auxiliary building ventilation system will be adequately managed by these AMPs during the period of extended operation.

3.3.1.2 Staff Evaluation

The applicant described its AMR of the auxiliary building ventilation system for license renewal in two separate sections of its LRA, Section 2.3.3.1 and Table 3.3-1, pages 3.3-6 through 3.3-10. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the auxiliary building ventilation system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.1.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.1 and Table 3.3-1, pages 3.3-6 through 3.3-10. During its review, the staff determined that additional information was needed to complete its review and, on January 23, 2002, issued RAI 3.3-1. The staff's evaluation of the applicant's response to RAI 3.3-1, pertaining to aging of ventilation system flexible connectors, is documented in Section 3.3.39.3 of this SER, and is characterized as resolved.

In a letter dated November 14, 2002, the applicant submitted its response to SER open item 2.3-3 pertaining to the applicant's treatment of structural sealants (subcomponents of structural members) in certain ventilation system applications for which pressure boundary integrity was an intended function. The applicant identified cracking and shrinkage of structural sealants in the interface between a structural wall, floor, or ceiling and a nonstructural component (such as a duct, piping, electrical cables, doors, and nonstructural walls) resulting from exposure to ambient conditions as potential aging effects.

The staff finds that the aging effects that result from contact of the auxiliary building ventilation system SSCs to the environments described in LRA Section 2.3.3.1 and Table 3.3-1, pages 3.3-6 through 3.3-10, and in correspondence from the applicant, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.1.2.2 Aging Management Programs

LRA Section 2.3.3.1 and Table 3.3-1, pages 3.3-6 through 3.3-10, state that the following aging management programs are credited for managing the aging effects in the auxiliary building ventilation system components:

- Fluid Leak Management Program
- Heat Exchanger Preventive Maintenance Activities — Pump Motor Handling Units
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components

In its November 14, 2002, response to SER open item 2.3-3, the applicant identified the Ventilation Area Pressure Boundary Sealants Inspection to manage the effects of cracking and shrinkage of structural sealant due to exposure to ambient conditions.

The Fluid Leak Management Program, Heat Exchanger Preventive Maintenance Activities — Pump Motor Handling Units Program, Chemistry Control Program, Inspection Program for Civil Engineering Structures and Components, and Ventilation Area Pressure Boundary Sealants Inspection are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-1, and correspondence from the applicant, the staff concludes that the above identified AMPs will effectively manage the aging effects of the auxiliary building ventilation system, and that there is reasonable assurance that the intended functions of the auxiliary building ventilation system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.1.3 Conclusions

The staff reviewed the information in Section 2.3.3.1 and Table 3.3-1 of the LRA and in correspondence from the applicant . On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the auxiliary building ventilation system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2 Boron Recycle System

3.3.2.1 Technical Information in the Application

The boron recycle system is essentially the same, and performs the same function, for McGuire and Catawba. The boron recycle system receives borated effluent from the RCS and associated support systems. This borated effluent is demineralized, filtered, and separated into 4 weight percent boric acid and reactor makeup water for reuse. The boron recycle system also provides reactor grade flush water for components in the auxiliary and reactor buildings. The McGuire and Catawba UFSARs provide more detailed descriptions in Sections 9.3.6 and 9.3.5, respectively.

3.3.2.1.1 Aging Effects

Components of the boron recycle system are described in Section 2.3.3.2 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-2, pages 3.3-11 through 3.3-15, lists individual components of the system, including the eductors, filters, flow meters, orifices, pipes, demineralizers, tanks, strainers, tubing, and valve bodies. Stainless steel components are identified as being subject to cracking and loss of material from exposure to the internal environment of borated and treated water. Exposure of stainless steel to sheltered, air-gas, and reactor building environments have no aging effects. Carbon steel components are subject to the aging effect of loss of material from internal and external surfaces from sheltered and treated water environments. Carbon steel is also subject to a air-gas environment with no aging effect.

3.3.2.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the boron recycle system:

- Fluid Leak Management Program
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components
- Flow-Accelerated Corrosion Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the boron recycle system will be adequately managed by these aging management programs during the period of extended operation.

3.3.2.2 Staff Evaluation

The applicant described its AMR of the boron recycle system for license renewal in two separate sections of its LRA, Section 2.3.3.2 and Table 3.3-2, pages 3.3-11 through 3.3-15. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the boron recycle system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.2 and Table 3.3-2, pages 3.3-11 through 3.3-15. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3.2-1, the applicant to indicate if Note (3), which was listed at the back of Table 3.3-2 and implied that portions of the boron recycle system may be subject to alternate wetting and drying, was applicable to any of the components listed in Table 3.3-2. In its RAI, the staff further requested the applicant to explain, if Note (3) did apply, how this environment and associated aging effects are managed in the LRA. In its response dated March 15, 2002, the applicant acknowledged that Note (3) did not apply to the boron recycle system, and that no components of this system are subject to alternate wetting and drying.

By letter dated January 23, 2002, the staff requested, in RAI-3.3.2-2, the applicant to indicate if Note (1), which was listed at the back of Table 3.3-2 and contained a definition for a component function of "HT" (heat transfer), applied to components listed in Table 3.3-2. In its response dated March 15, 2002, the applicant acknowledged that Note (1) did not apply to the boron recycle system, and that no components of this system have a "HT" or "TH" (throttle) function.

Since the system does not have a "HT" or "TH" function, the staff finds that the applicant's response clarifies and satisfactorily resolves this item. The aging effects that result from contact of the boron recycle system SSCs to the environments described in LRA Section 2.3.3.2 and Table 3.3-2, pages 3.3-11 through 3.3-15, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.2.2.2 Aging Management Programs

LRA Table 3.3-2, pages 3.3-11 through 3.3-15, states that the following aging management programs are credited for managing the aging effects in the boron recycle system:

- Fluid Leak Management Program
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components
- Flow-Accelerated Corrosion Program

The Fluid Leak Management Program, Chemistry Control Program, Inspection Program for Civil Engineering Structures and Components, and Flow-Accelerated Corrosion Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-2, the staff concludes that the above identified AMPs will effectively manage the aging effects of the boron recycle system, and that there is reasonable assurance that the intended functions of the boron recycle system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3 Conclusions

The staff reviewed the information in Section 2.3.3.2 and Table 3.3-2 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the boron recycle system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.3 Building Heating Water System

3.3.3.1 Technical Information in the Application

The McGuire building heating water system provides normal heating requirements of the auxiliary building ventilation system, fuel pool ventilation system, containment and in-core instrumentation room purge system, service building ventilation system, and the turbine building heating system. The Catawba building heating water system supplies hot water to the heating coils of various heating, ventilation, and air conditioning (HVAC) units throughout the plant.

For both McGuire and Catawba, the building heating water system is a non-safety-related system whose postulated failure could prevent satisfactory accomplishment of certain safety-related functions. To preclude these postulated failures, portions of this system are seismically designed. All components within the seismically designed piping boundaries of this system are within the scope of license renewal per 10CFR 54.4(a)(2).

3.3.3.1.1 Aging Effects

Components of the building heating water system are described in Section 2.3.3.3 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-3, page 3.3-16, lists individual components of the system, including pipes and valve bodies. Stainless steel components are identified as being subject to cracking and loss of material from exposure to the internal environment of treated water. Exposure of stainless steel to sheltered environments has no associated aging effects. Carbon steel components are subject to the aging effect of loss of material from internal surfaces from a treated water environment. Carbon steel is also subject to an aging effect of loss of material from exposure to sheltered environments.

3.3.3.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the building heating water system:

- Fluid Leak Management Program
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the building heating water system will be adequately managed by these aging management programs during the period of extended operation.

3.3.3.2 Staff Evaluation

The applicant described its AMR of the building heating water system for license renewal in two separate sections of its LRA, Section 2.3.3.3 and Table 3.3-3, page 3.3-16. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the building heating water system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.3.2.1 Aging Effects

The aging effects that result from contact of the building heating water system SSCs to the environments described in Section 2.3.3.3 and Table 3.3-3, page 3.3-16, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.3.2.2 Aging Management Programs

Section 2.3.3.3 and Table 3.3-3, page 3.3-16, of the LRA state that the following aging management programs are credited for managing the aging effects in the building heating water system:

- Fluid Leak Management Program
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components

The Fluid Leak Management Program, Chemistry Control Program, and Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-3, the staff concludes that the above identified AMPs will effectively manage the aging effects of the building heating water system, and that there is reasonable assurance that the intended functions of the building heating water system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.3.3 Conclusions

The staff reviewed the information in Section 2.3.3.3 and Table 3.3-3, page 3.3-16, of the LRA. On the basis of its review, the staff finds that the applicant has demonstrated that the aging effects associated with the building heating water system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.4 Chemical and Volume Control System

3.3.4.1 Technical Information in the Application

The CVCS is an integral part of the ECCS and provides high pressure injection and recirculation of borated water to the RCS cold legs following small and large break loss of coolant accidents and main steam line break accidents. The CVCS is also used to provide negative reactivity, by boron injection, to the core. The McGuire and Catawba UFSARs provide more detailed descriptions in Section 9.3.4.

3.3.4.1.1 Aging Effects

Components of the CVCS are described in Section 2.3.3.4 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Tables 3.3-4 and 3.3-5, pages 3.3-17 through 3.3-37, list individual components of the system, including pipes, valve bodies, boric acid blenders, filters, tanks, pump casings, meters, resin traps, demineralizers, heat exchangers, orifices, accumulators, stabilizers, spray nozzles, dampeners, and tubing. Stainless steel components are identified as being subject to cracking and loss of material from exposure to the internal and external environments of borated and treated water. Exposure of stainless steel to sheltered, gas, reactor building, and ventilation environments has no aging effects. Carbon steel components are subject to the aging effect of loss of material and cracking from the internal environment of treated water. Carbon steel is also subject to an aging effect of loss of material from exposure to sheltered and reactor building environments. Exposure of carbon steel components to an internal gas environment has no aging effect. Cast austenitic stainless steel exposed to a borated environment is subject to the aging effects of cracking and loss of material. Exposure of cast austenitic stainless steel to a reactor building environment has no aging effect identified.

3.3.4.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the CVCS:

- Fluid Leak Management Program
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the CVCS will be adequately managed by these aging management programs during the period of extended operation.

3.3.4.2 Staff Evaluation

The applicant described its AMR of the CVCS for license renewal in three separate sections of its LRA, Section 2.3.3.4 and Tables 3.3-4 and 3.3-5, pages 3.3-17 through 3.3-37. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the CVCS will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.4.2.1 Aging Effects

The aging effects that result from contact of chemical and volume control SSCs to the environments described in LRA Section 2.3.3.4 and Tables 3.3-4 and 3.3-5, pages 3.3-17 through 3.3-37, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.4.2.2 Aging Management Programs

LRA Section 2.3.3.4 and Tables 3.3-4 and 3.3-5, pages 3.3-17 through 3.3-37, state that the following aging management programs are credited for managing the aging effects in the CVCS:

- Fluid Leak Management Program
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components

The Fluid Leak Management Program, Chemistry Control Program, and Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Tables 3.3-4 and 3.3-5, the staff concludes that the above identified AMPs will effectively manage the aging effects of the CVCS, and that there is reasonable assurance that the intended functions of the CVCS will remain consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.4.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.4 and Tables 3.3-4 and 3.3-5, pages 3.3-17 through 3.3-37. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the CVCS will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.5 Component Cooling System

3.3.5.1 Technical Information in the Application

The Component Cooling System is essentially the same, and performs the same function, for McGuire and Catawba. The component cooling system is a closed loop system that maintains cooling to the essential header components, as required for plant conditions; maintains an intermediate system pressure boundary between the RCS and the nuclear service water system to prevent potential radioactive release; provides containment isolation; and maintains containment closure for shutdown. The McGuire and Catawba UFSARs provide more detailed descriptions in Sections 9.2.4 and 9.2.2, respectively.

3.3.5.1.1 Aging Effects

Components of the component cooling system are described in LRA Section 2.3.3.5 as being within the scope of license renewal and subject to an AMR. LRA Tables 3.3-6 and 3.3-7, pages 3.3-38 through 3.3-83, list individual components of the system, including pipes, valve bodies, flex hoses, heat exchangers, condensers, coolers, tanks, orifices, pump casings, and tubing. Stainless steel components are identified as being subject to cracking and loss of material from exposure to the internal and external environments of borated, treated water, and treated water (alternate wet/dry). Exposure of stainless steel to sheltered, reactor building, and ventilation environments have no aging effects. Carbon steel components are subject to the aging effect of loss of material and cracking from the internal environment of treated water. Carbon steel is also subject to an aging effect of loss of material to internal surfaces from raw water, and external surfaces from exposure to sheltered and reactor building environments. Exposure of carbon steel components to an oil environment has no aging effect. Inconel 625 exposed to a treated water environment is subject to the aging effects of cracking and loss of material. Exposure of Inconel 625 to reactor building environment has no aging effect. Exposure of cast austenitic stainless steel to a reactor building environment has no aging effect identified. Internal surfaces of admiralty brass components are identified as being subject to the aging effects of fouling and loss of material from being exposed to a raw water environment. External surfaces of admiralty brass components are subject to the aging effects of cracking, fouling, and loss of material from exposure to a treated water environment. Copper alloy components are identified as being subject to the aging effects of cracking and loss of material from the treated water environment. Internal surfaces of copper-nickel components are subject to the aging effects of cracking, loss of material, and fouling from exposure to treated water. External surfaces of copper-nickel components exposed to oil and ventilation environments demonstrate no aging effects, while those exposed to sheltered environments experience the aging effect of loss of material.

3.3.5.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the component cooling system:

- Performance Testing Activities — Component Cooling Heat Exchanger
- Heat Exchanger Preventive Maintenance Activities — Component Cooling
- Fluid Leak Management Program
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components
- Liquid Waste System Inspection

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the component cooling system will be adequately managed by these aging management programs during the period of extended operation.

3.3.5.2 Staff Evaluation

The applicant described its AMR of the component cooling system for license renewal in two separate sections of its LRA, Section 2.3.3.5 and Tables 3.3-6 and 3.3-7, pages 3.3-38 through 3.3-83. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the component cooling system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.5.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.5 and Tables 3.3-6 and 3.3-7, pages 3.3-38 through 3.3-83. During its review, the staff determined that additional information was needed to complete its review. Tables 3.3-6 and 3.3-7 (page 3.3-38 and 3.3-83), indicate that certain reactor coolant (NC) pump motor upper and lower bearing cooler components have a treated water internal environment with an oil external environment. By letter dated January 23, 2002, the staff requested, in RAI 3.3-3, the applicant to indicate where in the LRA the aging effect of loss of material to these components with oil systems subject to water contamination were addressed.

In its response dated March 15, 2002, the applicant stated that all of the lube oil cooler components cited in the first paragraph of RAI 3.3-3 are components of closed oil recirculation systems. Uncontaminated lube oil does not cause aging, and closed oil recirculation systems are assumed to be initially free of contaminants, such as water. Further, in the Duke aging management review, component failures were not postulated as a means to establish the relevant conditions required for aging to occur. Therefore, oil cooler tube failures that could introduce water into a lube oil environment were not assumed.

The staff agrees that uncontaminated oil will not cause any aging effect to the components, and that the applicant is not required to assume a failure that can cause an aging effect. The staff finds that the applicant's response to RAI 3.3-3 clarifies and satisfactorily resolves this item. The aging effects that result from contact of component cooling SSCs to the environments described in LRA Section 2.3.3.5 and Tables 3.3-6 and 3.3-7, pages 3.3-38 through 3.3-83, are consistent with industry experience for these combinations of materials and environments. The staff finds that the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.5.2.2 Aging Management Programs

Tables 3.3-6 and 3.3-7 of the LRA state that the following aging management programs are credited for managing the aging effects in the component cooling system:

- Performance Testing Activities — Component Cooling Heat Exchanger
- Heat Exchanger Preventive Maintenance Activities — Component Cooling
- Fluid Leak Management Program
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components
- Liquid Waste System Inspection

The Fluid Leak Management Program, Chemistry Control Program, Inspection Program for Civil Engineering Structures and Components, and Liquid Waste System Inspection Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in

Section 3.0 of this SER. The staff's evaluation of the Performance Testing Activities — Component Cooling Heat Exchanger Program and the Heat Exchanger Preventive Maintenance Activities — Component Cooling program follows.

Performance Testing Activities — Component Cooling Heat Exchangers

The applicant described its component cooling heat exchangers performance testing activities in Section B.3.17.1.1 of LRA Appendix B. The staff reviewed the LRA to determine whether the applicant had demonstrated that this program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In Section B.3.17.1.1 of LRA Appendix B, the applicant stated the purpose of the component cooling heat exchangers performance testing activities and the methods used to monitor and trend the performance of the heat exchangers. The purpose of this program is to manage fouling of admiralty brass and stainless steel heat exchanger tubes that are exposed to raw water. This is a performance monitoring program that monitors specific component parameters to detect the presence of fouling which can affect the heat transfer function of the component.

The staff's evaluation of the Performance Testing Activities — Component Cooling Heat Exchangers focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below:

[Program Scope] The scope of this program includes the McGuire and Catawba component cooling heat exchanger tubes. The staff finds the scope of the program to be acceptable because the information in the application, and in the applicant's response to the staff's RAI, is comprehensive in that it includes the components of the component cooling heat exchangers that are subject to an AMR.

[Preventive or Mitigative Actions] The applicant stated that no actions are taken as part of this program to prevent aging effects or to mitigate aging degradation. This is a performance monitoring activity. The staff considers the performance testing activities as a means of detecting, not preventing aging. Therefore, the staff agrees that there are no preventive measures to be taken or required.

[Parameters Monitored or Inspected] The Performance Testing Activities — Component Cooling Heat Exchangers involves monitoring of flow capacity by performance of a differential pressure test to provide an indication of fouling. By letter dated January 28, 2002, the staff requested, in RAI B.3.17-1, additional information from the applicant regarding the flow rates in the component cooling heat exchangers and the susceptibility to flow-induced corrosion. In its response dated March 15, 2002, the applicant indicated that normal or design velocities were reviewed for each heat exchanger to determine whether flow-induced corrosion is applicable. The applicant found that flow-induced corrosion is not an applicable aging effect for any heat exchanger subject to an aging management review. The staff agreed that the differential pressure test is an appropriate method to monitor system performance because it provides a clear indication of tube fouling.

[Detection of Aging Effects] The applicant described the performance testing activities that will be used to detect fouling prior to loss of component heat transfer function. The staff agrees that this testing is appropriate because it will provide information to the applicant prior to loss of component function.

[Monitoring and Trending] The applicant stated that the Performance Testing Activities — Component Cooling Heat Exchangers program measures the pressure drop through the heat exchanger tubes. An increase in pressure drop indicates the presence of fouling. At McGuire, the applicant indicated that the pressure drop through the heat exchanger tubes is continuously monitored, and the pressure drop evaluated against the acceptance criteria. Because the parameter is continuously monitored, the staff finds this acceptable.

At Catawba, a periodic differential pressure test is performed. The test results are trended against a baseline value for indication of tube cleanliness. The frequency of testing at Catawba permits the results of the testing to be trended to determine when corrective action is required. The staff reviewed the monitoring and trending activities that are relied on by the applicant and found that they are consistent with current industry practice and, therefore, are acceptable to the staff.

[Acceptance Criteria] At McGuire, where the differential pressure is continuously monitored, the acceptance criteria are in the form of alarm points. An alarm point is provided for high differential pressure and for a high-high differential pressure. At Catawba, the acceptance criterion is in the form of a flow resistance factor value. The acceptable value at both plants is based on a design resistance factor for "clean" heat exchanger tubes. The staff finds both acceptance criteria to be appropriate because they provide the operators with information that will allow action to be taken prior to loss of component function.

[Operating Experience] The applicant reported that operating experience associated with the Performance Testing Activities — Component Cooling Heat Exchangers has demonstrated that monitoring of flow through the heat exchangers provides adequate information on the extent of fouling present in the tubes to predict when corrective action is required. Corrective action, in the form of flushing or tube cleaning, for example, is performed before the heat transfer function of the heat exchanger tubes is degraded below its required capacity. The applicant's experience has demonstrated that both of these techniques permit the fouling to be monitored, and any required corrective actions to be performed before the heat transfer function degrades below acceptable limits. The results of trending (at Catawba) for the heat exchanger tube fouling have resulted in the performance of cleaning activities. The applicant has tested different types of cleaning mechanisms (i.e., darts, brushes, high pressure water laze, etc.) in order to maximize the effectiveness of the cleaning. Cleaning activities have restored the condition of the tube surfaces by removal of fouling materials. The applicant has trended the length of time between required cleaning in order to determine the most effective cleaning process and methods.

[McGuire-Specific Operating Experience] The applicant stated that experience with flow monitoring at McGuire has indicated that the alarm point setting permits action before the differential pressure limit is reached. The applicant reported that the combination of high velocity flushes and better cleaning during outages have almost eliminated on-line cleaning of the heat exchanger tubes. On the basis of the McGuire operating experience, the staff finds that the performance testing activities are capable of identifying and correcting fouling conditions before loss of component function.

[Catawba-Specific Operating Experience] The applicant stated that experience with the flow tests at Catawba has indicated that the stainless steel tubes foul slightly faster than the original brass tubes. High velocity flushing every 6 to 8 weeks has been used by the applicant and been found to be potentially effective in reducing fouling and prolonging heat exchanger service between tube cleaning. The staff finds that the applicant's heat exchanger performance monitoring activities for the component cooling heat exchangers operating experience have demonstrated the effectiveness of the program in identifying and correcting fouling prior to loss of component intended function.

FSAR Supplement: In LRA Appendix A-1, Section 18.2.13.1 ,and LRA Appendix A-2, Section 18.2.12.1, the applicant has provided proposed FSAR supplements for McGuire and Catawba, respectively. The staff reviewed this information and found it to be consistent with the information provided in Appendix B, Section B.3.17.1.1 and is, therefore, acceptable.

In conclusion, the staff reviewed the information in Section B.3.17.1.1 of the LRA and the applicant's response to the staff's request for additional information. On the basis of its review and the above evaluation, the staff finds that there is reasonable assurance that the applicant has demonstrated that the effects of aging associated with the Performance Testing Activities — Component Cooling Heat Exchangers program 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).

Heat Exchanger Preventive Maintenance Activities — Component Cooling

The applicant described its Heat Exchanger Preventive Maintenance Activities — Component Cooling program in Section B.3.17.1.2 of LRA Appendix B. The staff reviewed the LRA to determine whether the applicant had demonstrated that this program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Section B.3.17.1.2 of LRA Appendix B describes the applicant's preventive maintenance activities for the component cooling water heat exchangers, tubesheets, and channel heads. The purpose of these activities is to manage loss of material for parts of the component cooling heat exchanger exposed to raw water. This program is described by the applicant as a condition monitoring program that monitors specific component parameters to detect the presence, and assess the extent, of material loss that can affect the pressure boundary function. This program is credited with managing loss of material for admiralty brass, carbon steel, and stainless steel materials.

The staff's evaluation of the Heat Exchanger Preventive Maintenance Activities — Component Cooling program focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The applicant described the scope of the Heat Exchanger Preventive Maintenance Activities — Component Cooling program to include the McGuire and Catawba component cooling heat exchanger tubes, tubesheets, and channel heads. The staff finds this scope to be appropriate because it includes those components important to the proper functioning of the component cooling system heat exchangers.

[Preventive or Mitigative Actions] The applicant did not identify any actions taken as part of this program to prevent aging effects, or to mitigate aging degradation. The staff agrees that the purpose of the program is not to prevent loss of material, but to perform inspections which will identify loss of material in the inspected components and allow actions to be taken prior to loss of component function.

[Parameters Monitored or Inspected] The applicant stated that the Heat Exchanger Preventive Maintenance Activities — Component Cooling program inspects the heat exchanger tubes, tubesheetS, and channel head surfaces for loss of material. The staff agrees that inspection of these components will permit actions to be taken prior to loss of component function.

[Detection of Aging Effects] In accordance with the information provided by the applicant under monitoring and trending, the Heat Exchanger Preventive Maintenance Activities — Component Cooling program will detect loss of material due to crevice, galvanic, general, pitting, and microbiologically influenced corrosion, and particle erosion prior to loss of the component pressure boundary function. The staff finds that the inspections are consistent with what is done in the industry, and are capable of detecting aging effects. Therefore, the staff finds that the methods are appropriate.

[Monitoring and Trending] The applicant stated that the Heat Exchanger Preventive Maintenance Activities — Component Cooling program performs eddy current testing on the heat exchanger tubes to measure wall thickness in order to detect areas with loss of material. Trending is performed in order to predict a heat exchanger replacement or repair schedule. The applicant stated that non-destructive testing (NDT) is performed on approximately 50 percent of the tubes of each heat exchanger, as determined by routine differential pressure testing, based on operating experience and engineering evaluation of test data.

The applicant stated that, with the exception of one Catawba heat exchanger that has no coated components, loss of material of the tubesheets and channel heads of all component cooling heat exchangers is managed by a visual inspection of the protective coatings to assure the integrity of the underlying base metal. This inspection is performed as determined by routine differential pressure testing. The tubesheet and channel heads of the component cooling heat exchangers are coated with a high solids epoxy. The coating inspection specifically identifies rust blooms, which indicate a coating defect and corrosion of the base metal. No actions are taken as part of this visual inspection to trend results.

One Catawba component cooling heat exchanger does not currently have any coatings applied to the tubesheets or channel heads. These parts of the heat exchanger are monitored by ultrasonic testing to detect loss of material, and the results are trended. This inspection is performed as required based on trending results.

As a result of the evaluation, the staff finds that the monitoring and trending activities are appropriate for the components being evaluated, both in scope and frequency. The visual inspections are capable of identifying rust blooms, indicating a coating defect and corrosion of the base metal. The ultrasonic testing is capable of detecting metal loss. Therefore, the staff agrees that the monitoring and trending procedures are appropriate.

[Acceptance Criteria] The applicant identified the acceptance criterion for the Heat Exchanger Preventive Maintenance Activities — Component Cooling program as no unacceptable loss of material of the tubes, tubesheets, and channel heads that could result in a loss of the component intended function(s), as determined by engineering evaluation. The staff found that the applicant's acceptance criterion for this program was not adequate to make a reasonable assurance finding, and requested the applicant to specify parameters with quantitative limits or provide specific acceptance criteria (e.g., comparison to design criteria, operating requirements, etc.) that are implemented at Catawba and McGuire to allow for actions to be taken prior to a loss of component function. This issue was characterized as SER open item 3.0.3.9.1.2(d).

In its response to SER open item 3.0.3.9.1.2(b-g), dated October 28, 2002, the applicant indicated that eddy current testing is the method used to manage loss of material of the subject heat exchanger tubes. Eddy current testing is a standard industry practice used for detecting wall loss in heat exchangers, but requires careful engineering evaluation of all test results to provide the proper management of a heat exchanger. Steam generators are the only plant heat exchangers for which station technical specifications or sets of standards exist to define the flaw depth at which a tube must be plugged and removed from service.

For the low pressure, low temperature heat exchangers to which SER open items 3.0.3.9.1.2 (b-g) apply, evaluating eddy current test results for "unacceptable loss of material" involves many variables, such as tube material, characterization of the indication in terms of percent wall loss, rate of degradation as compared to previous indications, and the frequency of subsequent testing. Criteria such as ASME Code requirements, additional inspection results, and operating experience may be used to assess the severity of the degradation and the need for corrective actions.

The applicant further explained that eddy current testing at McGuire and Catawba is performed by a vendor who specializes in the practice. A 4-step process is used to determine if test results are acceptable and to generate the final test report. This process is described in detail in the applicant's October 28, 2002, response to this SER open item. The following is the process described by the applicant:

> (1) At the conclusion of testing of a component, the vendor's eddy current testing manager reviews the data and makes a plugging recommendation in the preliminary report based on his assessment of the damage flaws and experience with testing the component. Experience demonstrates that these specialists generally recommend evaluation at around a 70 percent wall loss range.
>
> (2) Duke then reviews the entire test data provided in the preliminary test report, including the recommendation for plugging, prior to returning the component to service. Duke evaluates the recommendations using all the information they have available. Particularly, Duke evaluates the

rate of degradation based on the history of the tube. The wall loss may be deemed acceptable if the tube is showing minimal to no degradation from previous inspections. Consideration is also given to the frequency of the next inspection; if frequent inspection is performed, then a higher wall loss range may be acceptable and if less frequent inspection is performed then lower wall loss range may be unacceptable.

(3) Depending on the type of tubing material and tubing damage detected with eddy current testing and possibly verified with actual tube pulled samples, a wall loss correlation may be determined as a threshold for evaluating the tube for plugging repair. Past operating experience with the type of tubing flaw may also be a very useful factor in determining the wall loss plugging threshold.

(4) The loss of material experienced by these heat exchanger tubes generally manifests itself as pits. These pitting flaws are not very likely to fail heat exchanger tubing due to mechanical stress of pressure and temperature due to the shouldered nature or material reinforcement around pits. Therefore, the pitting rate as determined from past eddy current testing experience becomes the primary factor to consider when selecting tubes to remove from service to prevent later on-line tube leaks.

The applicant further stated that its experience in evaluating eddy current testing results has proven to be effective during the operation of McGuire and Catawba. Corrective actions, such as tube plugging and tube bundle and heat exchanger replacement, have been taken as a result of failed acceptance criteria of the subject programs. On the basis of the information provided in the applicant's October 28, 2002, open item response, the staff finds that appropriate and adequate acceptance criteria for detecting heat exchanger tube degradation from loss of material are identified for these aging management programs. Therefore, open items 3.0.3.9.1.2(b-g) are closed.

[Operating Experience] The applicant stated that operating experience associated with the Heat Exchanger Preventive Maintenance Activities — Component Cooling program has demonstrated that the eddy current testing provides adequate information on the extent of wall loss present in the heat exchanger tubes to predict when corrective action is required. Corrective action in the form of tube plugging, for example, is performed before the loss of the component intended function. The applicant stated, and the staff agreed, that plant operating experience has demonstrated that measurement and trending of tube wall thickness provides an accurate indication of material condition.

Additionally, the applicant stated that operating experience associated with the Heat Exchanger Preventive Maintenance Activities — Component Cooling program has demonstrated that protective coatings are effective in preventing loss of material on the tubesheets and channel heads. Inspection of the coatings ensures that the protective features of the coatings are maintained intact. Plant operating experience has demonstrated that visual inspection of the coatings provides an accurate indication of material condition. The applicant's experience prior to application of the coatings, and with the tubesheets and channel heads that have not been coated, indicates that loss of material may occur without protective coatings.

The applicant's measurement and trending of tubesheet and channel head wall thickness using ultrasonic techniques provides an accurate indication of material condition. The frequency of monitoring permits the results to be trended in order to determine when corrective action is required.

Based on the review of the applicant's operating experience, the staff finds that the inspections and monitoring activities have demonstrated that the techniques being used allow for the trending of the loss of material and any required corrective actions to be performed before the loss of component intended function.

FSAR Supplement: In LRA Appendix A-1, Section 18.2.13.1, and LRA Appendix A-2, Section 18.2.12.1, the applicant provided proposed FSAR supplements for McGuire and Catawba, respectively. The staff reviewed this information and found it to be consistent with the information provided in Appendix B, Section B.3.17.1.2 and is, therefore, acceptable.

The staff has reviewed the information in Section B.3.17.1.2 of LRA Appendix B. On the basis of this review and the above evaluation, and with the resolution of open item 3.0.3.9.1.2(d), the staff finds that there is reasonable assurance that the applicant has demonstrated that the effects of aging associated with the Heat Exchanger Preventive Maintenance Activities — Component Cooling program 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).

Based on its review of Tables 3.3-6 and 3.3-7 and Appendix B of the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the component cooling system, and that there is reasonable assurance that the intended functions of the component cooling system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.5.3 Conclusions

The staff reviewed the information in Section 2.3.3.5, Tables 3.3-6 and 3.3-7, and Section B.3.17 of LRA Appendix B. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the component cooling system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.6 Condenser Circulating Water System

3.3.6.1 Technical Information in the Application

The condenser circulating water system provides a suction source of water to the turbine-driven auxiliary feedwater pump for events requiring the activation of the standby shutdown facility. The McGuire and Catawba UFSARs provide more detailed descriptions in Section 10.4.5.

3.3.6.1.1 Aging Effects

Components of the condenser circulating water system are described in Section 2.3.3.6 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-8, pages 3.3-84 through 3.3-86, lists individual components of the system, including pipes, valve bodies, pump casings, and strainers. Carbon steel components are subject to the aging effect of loss of material from internal surfaces from a raw water environment. External surfaces of carbon steel are also subject to the aging effect of loss of material from exposure to sheltered, underground, and yard environments. Carbon steel in an embedded environment is not subject to any aging effect.

3.3.6.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the condenser circulating water system:

- Galvanic Susceptibility Inspection
- Preventive Maintenance Activities — Condenser Circulating Water System Internal Coating Inspection
- Inspection Program for Civil Engineering Structures and Components

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the condenser circulating water system will be adequately managed by these aging management programs during the period of extended operation.

3.3.6.2 Staff Evaluation

The applicant described its AMR of the condenser circulating water system for license renewal in two separate sections of its LRA, Section 2.3.3.6 and Table 3.3-8, pages 3.3-84 through 3.3-86. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the condenser circulating water system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.6.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.6 and Table 3.3-8, pages 3.3-84 through 3.3-86. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3-4, additional information pertaining to Table 3.3-8. In Table 3.3-8, the applicant indicates that Catawba and McGuire carbon steel condenser circulating water system components are subject to an internal environment of raw water. The staff requested that the applicant confirm that strainers do not perform a component function that may be degraded by the aging effect of fouling in a raw water environment. Similarly, staff requested that the applicant confirm that neither orifices nor strainers, identified in Table 3.3-36, Aging Management Review Results — Nuclear Service Water System (McGuire Nuclear Station), and Table 3.3-37, Aging Management Review Results — Nuclear Service Water System (Catawba Nuclear Station), perform a component function that may be degraded by the aging effect of fouling from exposure to raw water.

In its response dated March 15, 2002, the applicant stated that the strainers in the condenser circulating water system (Table 3.3-8 for both McGuire and Catawba), and in the nuclear service water system (Table 3.3-36 for McGuire and 3.3-37 for Catawba), have a component intended function to maintain pressure boundary integrity. The component intended function of the strainer to maintain pressure boundary integrity will not be degraded by fouling. The orifices in the nuclear service water system (Table 3.3-36 for McGuire and 3.3-37 for Catawba) have two component intended functions (1) to maintain pressure boundary integrity, and (2) to throttle flow. Fouling will not degrade either the pressure boundary function or the throttling function of the orifices. The staff agrees with the applicant that fouling is not an applicable aging effect since heat transfer is not an intended function that meets the scoping criteria of 10 CFR 54.4. The staff finds that the applicant's response clarifies and satisfactorily resolves this item.

In its April 15, 2002, response to RAI 2.3.3.6-6, the applicant determined that expansion joints on the discharge of the Catawba condenser cooling water pumps were within the scope of license renewal (see Section 2.3.3.6.2 of this SER). The following AMR results for these components were provided in the applicant's response:

Component Type	Component Function	Material	Internal Environment / External Environment	Aging Effect	Aging Management Programs and Activities
Expansion Joints	PB	Synthetic Rubber*	Raw Water / Yard	None Identified / None Identified	None Required / None Required

* A woven polyester and/or nylon fabric coated with chlorobutyl rubber.

The applicant indicated that the external surfaces of these expansion joints are exposed to a "yard" environment, and "no" aging effects are identified. The staff believed that there is potential degradation to the expansion joints if they are exposed to extensive UV rays in a yard environment. If these expansion joints are in a vault, shaded, or covered, then the staff agreed that there are no aging effects for the expansion joints. However, the definition of the yard environment provided in the LRA did not address sunlight exposure. This issue was characterized as SER open item 3.3.6.2.1-1.

During a meeting with the staff on September 18, 2002 (documented in a memorandum dated November 18, 2002), the applicant stated that the expansion joints are located in a pit. Since they are subject to limited UV rays, the applicant stated that degradation from UV is unlikely. However, the staff believes that additional aging effects may be applicable to the expansion joints over time.

In a letter dated October 19, 2002, the staff asked the applicant to provide a basis to justify a service life to the extended operating period (up to 60 years) without aging management or replacement. The staff's concern was that industry operating experience shows that the main condenser expansion joint constructed with similar materials are typically replaced after 20 to 30 years of service. The staff requested the applicant to provide a basis to justify a service life of the subject pump expansion joint to an extended life of up to 60 years without aging management or replacement.

During a conference call on October 31, 2002, the applicant stated that the main condenser expansion joints are subject to a very harsh environment. They are typically under high (vacuum) pressure, at temperatures higher than 200 to 300 °F, and are exposed to steam and water. The applicant stated that the condenser circulating water system pump expansion joints are subject to a very mild environment with ambient temperatures lower than 100 °F, low pressures, and exposure to raw water internally and outdoor air externally. The applicant also stated that no degradation had been noticed for the subject components during the life of the plant to date.

The applicant provided an official response in a letter dated November 5, 2002. The staff found that the operating environment that was specified for the main condenser seals differed from that which was conveyed by the applicant during the October 31, 2002, conference call. The staff was unable to close the SER open item because of the discrepancy regarding the temperature range to which a main condenser seal (over 100 °F) versus a condenser circulation water system expansion joint (under 100 °F) is typically exposed.

In its November 14, 2002, response, the applicant agreed to add cracking and wear as potential aging effects, and addressed the issue of potential degradation of the synthetic rubber expansion joint in the condenser circulating water system. It proposed to implement a one-time inspection of the expansion joints in order to characterize any cracking and wear of expansion joints exposed to raw water internal and yard external environments. Taking this safety precaution was needed because degradation on synthetic rubber in the expansion joints may cause failure of the pressure boundary in the condenser circulating water system during the period of extended operation. The applicant stated that, based on current operating experience, a one-time inspection of the expansion joints will be adequate for protecting the system.

By letter dated November 18, 2002, the applicant provided the following revised AMR results table for the condenser circulating water system expansion joints:

Component Type	Component Function	Material	Internal Environment / External Environment	Aging Effect	Aging Management Programs and Activities
Expansion Joints	Pressure Boundary	Synthetic Rubber	Raw Water	Cracking Wear	Condenser Circulating Water Pump Expansion Joint [Inspection]*
			Yard	Cracking Wear	Condenser Circulating Water Pump Expansion Joint [Inspection]*

* The staff interpreted the aging management program to be an inspection.

The aging effects that result from contact of condenser circulating water SSCs to the environments described in Section 2.3.3.6, LRA Table 3.3-8, and in correspondence from the applicant , are consistent with industry experience for these combinations of materials and environments. On the basis of its review, and with the resolution of open item 3.3.6.2.1-1, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.6.2.2 Aging Management Programs

The following aging management programs identified in LRA Section 2.3.3.6 and Table 3.3-8, pages 3.3-84 through 3.3-86, have been evaluated and found to be acceptable for managing the aging effects identified for the condenser circulating water system.

- Galvanic Susceptibility Inspection
- Preventive Maintenance Activities — Condenser Circulating Water System Internal Coating Inspection
- Inspection Program for Civil Engineering Structures and Components

The Galvanic Susceptibility Inspection Program, Preventive Maintenance Activities — Condenser Circulating Water System Internal Coating Inspection, and Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

In its November 14, 2002, response to SER open item 3.3.6.2.1-1, the applicant proposed to implement a one-time inspection of the expansion joints to characterize any cracking and wear of expansion joints exposed to a raw water internal environment and a yard external environment. Taking this safety precaution was needed because degradation of synthetic rubber in the expansion joints may cause failure of the pressure boundary in the condenser circulating water system during the period of extended operation. The applicant stated that, based on current operating experience, a one-time inspection of the expansion joints will be adequate for protecting the system.

<u>Condenser Circulating Water Pump Expansion Joint Inspection</u>

The staff's evaluation of the one-time inspection of the synthetic rubber expansion joint in the condenser circulating water system focuses on how the one-time inspection program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Scope] The applicant defined the scope of the one-time inspection to include the expansion joints in the condenser circulating water system for the Catawba plant. The staff finds that the scope is appropriate for the described purpose because it includes the components that may be affected by the environments to which they are exposed. Also, the component is exposed to a very mild environment with very limited UV exposure, ambient temperature, and very low pressure, and site operating experience has not revealed any evidence of degradation in the current operating term. Therefore, the staff agrees that a one-time inspection is adequate to verify that aging effects will not cause a loss of intended function during the period of extended operating.

[Preventive Actions] No preventive actions are taken as part of this inspection to prevent aging effects or to mitigate aging degradation. The staff agrees with the applicant because the purpose of the program is to inspect and determine the condition of the inspected components, rather than prevent their damage.

[Parameters Monitored or Inspected] The applicant stated that the parameters monitored by the Condenser Circulating Water Expansion Pump Joint Inspection consist of signs of cracking and wear from exposure to the internal and external environments. The staff finds the parameters monitored to be acceptable because they represent the type of damage expected in the environments to which these components are exposed.

[Detection of Aging Effects] The applicant stated that the Condenser Circulating Water Pump Expansion Joint Inspection is a one-time visual inspection that will detect the presence and extent of degradation of the internal and external surfaces of the synthetic rubber expansion joints. The staff finds this inspection acceptable because it would successfully detect relevant aging effects.

[Monitoring and Trending] The applicant stated that the Condenser Circulating Water Pump Expansion Joint Inspection involves a one-time visual inspection of the internal and external surfaces of the expansion joints in the scope of license renewal for specific signs of cracking, checking, crazing, cuts, tears, blistering, abnormal bulges, scale, flakes, and soft spots. Monitoring and trending of inspection results are not features of this inspection because it will be performed once to verify that the rubber expansion joints are not degrading. For Catawba, this activity will be implemented following issuance of the renewed operating licenses. The staff finds that these inspections will provide the applicant the means for determining the condition of the synthetic rubber expansion joints.

[Acceptance Criteria] The applicant stated that the acceptance criteria for the Condenser Circulating Water Pump Expansion Joint Inspection are based on the results of the evaluation of the inspection findings. The criteria are qualitatively based on the inspection findings, including cracking, checking, crazing, cuts, tears, blistering, abnormal bulges, scale, flakes, and soft spots. The staff concurs with the applicant that these results will allow the applicant determine the condition of the synthetic rubber joints.

[Operating Experience] The Condenser Circulating Water Pump Expansion Joint Inspection is a one-time inspection activity for which there is no operating experience. However, during the course of other maintenance activities, expansion joints have been inspected and were found to be in good condition. The staff concludes that there is a good chance that synthetic rubber in the expansion joint will not be degraded during the period of extended operation. Nonetheless, a one-time inspection is warranted to verify that aging effects will not cause a loss of the pressure boundary function for these components during the period of extended operation.

FSAR Supplement: In LRA Appendix A-1, Section 18.2.20, the applicant has provided an FSAR supplement for Catawba. The staff reviewed this information and found it to be consistent with the information provided in the response to open item 3.3.6.2.1-1. Therefore, the staff concludes that the proposed FSAR supplement for Catawba is acceptable.

The staff reviewed the applicant's response to open item 3.3.6.2.1-1. On the basis of its review and above evaluation, the staff finds that there is a reasonable assurance that the applicant has demonstrated that the effects of aging associated with the one-time inspection of the expansion joints in the condenser circulating water system 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).

Based on its review of the applicant response to open item 3.3.6.2.1-1, the staff concludes that the above identified AMP will effectively manage the aging effect of the expansion joints in the condenser circulating water system, and there is reasonable assurance that the intended functions of these components will remain consistent with the current licensing basis during the period of extended operation, as required by CFR 54.21(a)(3).

Based on its review of LRA Table 3.3-8, the staff concludes that the above identified AMPs will effectively manage the aging effects of the condenser circulating water system, and that there is reasonable assurance that the intended functions of the condenser circulating water system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.6.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.6, LRA Table 3.3-8, and in correspondence from the applicant. On the basis of its review, and with the resolution of open item 3.3.6.2.1-1, the staff concludes that the applicant has demonstrated that the aging effects associated with the condenser circulating water system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.7 Containment Ventilation System

3.3.7.1 Technical Information in the Application

The McGuire upper and lower containment ventilation systems provide cooling to the upper and lower compartments of containment during normal operation and shutdown. The upper and lower containment ventilation systems contain resistance temperature detectors (RTDs) that are required for post-accident monitoring in accordance with the environmental qualification rule. The staff's review of the applicant's environmental qualification program is documented in Section 4.4 of this SER. No mechanical components have an intended function; therefore, no aging management review is required.

3.3.7.2 Staff Evaluation

The applicant described its AMR of the containment ventilation system for license renewal in LRA Section 2.3.3.7. The staff reviewed this section of the LRA to determine whether the applicant had demonstrated that the effects of aging for the containment ventilation system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff finds that aging management is not applicable to this section, since there are no mechanical functions provided by any of the components that meet the scoping criteria of 10 CFR 54.4.

3.3.7.3 Conclusions

The staff concludes that, since there are no mechanical functions provided by any of the components that meet the scoping criteria of 10 CFR 54.4, an AMR is not required for this system.

3.3.8 Control Area Ventilation System and Chilled Water System

3.3.8.1 Technical Information in the Application

The control area ventilation system and control area chilled water system combine to form one system to provide the normal and emergency ventilation requirements to the control room and control room area. The McGuire and Catawba UFSARs provide more detailed descriptions in Sections 6.4 and 9.4.1, respectively.

3.3.8.1.1 Aging Effects

Components of the control area ventilation system and control area chilled water system are described in Section 2.3.3.8 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Tables 3.3-9, 3.3.10, and 3.3.11, pages 3.3-87 through 3.3-113, list individual components of the system, including pipes, valve bodies, pump casings, strainers, tubing, orifices, flow indicators, refrigerant filters, y-strainers, compression tanks, storage tanks, condenser shells, condenser tubes, tubesheets, channel heads, oil separators, oil filters, economizers, evaporator tubes, evaporator tubesheets, chemical feeders, ductwork, filter trains, and evaporator heads.

Carbon steel components are subject to the aging effect of loss of material and cracking of internal surfaces from a treated water environment. Internal surfaces of carbon steel are also subject to loss of material due to exposure to raw water. External surfaces of carbon steel are also subject to an aging effect of loss of material from exposure to sheltered environments. Exposure of internal or external carbon steel surfaces to gas or oil environments has no aging effects.

Internal surfaces of stainless steel components are subject to the aging effect of loss of material and cracking due to exposure to a treated water environment. Exposure of internal or external surfaces of stainless steel components to sheltered, gas, or oil environments has no aging effects. Cast iron components exposed to an internal environment of treated water are subject to the aging effect of loss of material, while external surfaces exposed to sheltered environments are also subject to the aging effect of loss of material. Exposure of cast iron to a gas or oil environment has no aging effect. Internal surfaces of copper-nickel components are subject to the aging effects of fouling and loss of material from exposure to raw water environment. Internal surfaces of copper-nickel components also experience the aging effect of loss of material due to exposure to a treated water environment. External surfaces of copper-nickel components exposed to a gas environment experience no aging effects.

Components made of copper exposed to a treated water environment experience the aging effects fouling and loss of material. Exposure of copper components to a gas environment results in no aging effect. Components made of admiralty brass exposed to a treated water environment experience the aging effects of cracking and loss of material. Copper components exposed to an oil environment do not experience any aging effects. There are no aging effects to the internal surfaces of galvanized steel and brass components exposed to a ventilation environment. External surfaces of galvanized steel and brass components exposed to yard and sheltered environments also do not experience any aging effects.

3.3.8.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the control area ventilation and chilled water systems:

- Fluid Leak Management Program
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components
- Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water
- Service Water Piping Corrosion Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the control area ventilation and chilled water systems will be adequately managed by these aging management programs during the period of extended operation.

3.3.8.2 Staff Evaluation

The applicant described its AMR of control area ventilation and chilled water systems for license renewal in four separate sections of its LRA, Section 2.3.3.8 and Tables 3.3-9, 3.3.10, and 3.3.11, pages 3.3-87 through 3.3-113. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the control area ventilation and chilled water systems will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.8.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.8 and Tables 3.3-9, 3.3.10, and 3.3.11, pages 3.3-87 through 3.3-113. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAIs 3.3-1 and 3.3-3, additional information from the applicant. The staff's evaluation of the applicant's response to RAI 3.3-1, pertaining to aging of ventilation system flexible connectors, is documented in Section 3.3.39.3 of this SER, and is characterized as resolved.

In RAI 3.3-3, the staff requested the applicant to address information provided in LRA Tables 3.3-9 (pages 3.3-91 to 3.3-93) and 3.3-10 (pages 3.3-103 to 3.3-104). These tables indicate that certain Catawba and McGuire control room area chiller components (oil cooler tubes, tubesheets, and shells) are subject to an internal/external environment of treated water/oil. In RAI 3.3-3, the staff requested the applicant to identify where in the LRA the aging effect of loss of material for these components in oil systems subject to water contamination was addressed.

In its response dated March 15, 2002, the applicant stated that all of the lube oil cooler components cited in the first paragraph of RAI 3.3-3 are components of closed oil recirculation systems. Uncontaminated lube oil does not cause aging, and closed oil recirculation systems are assumed to be initially free of contaminants, such as water. Further, in the Duke aging management review, component failures were not postulated as a means to establish the relevant conditions required for aging to occur. Therefore, in oil coolers, tube failures that could introduce water into a lube oil environment are not assumed. The staff agrees that uncontaminated oil will not cause any aging effect to the components, and that the applicant is not required to assume a failure that can cause an aging effect. The staff finds that the applicant's response to RAI 3.3-3 clarifies and satisfactorily resolves this item.

In a letter dated November 14, 2002, the applicant submitted its response to SER open item 2.3-3 pertaining to the applicant's treatment of structural sealants (subcomponents of structural members) in certain ventilation system applications for which pressure boundary integrity was an intended function. The applicant identified cracking and shrinkage of structural sealants in the interface between a structural wall, floor, or ceiling and a nonstructural component (such as a duct, piping, electrical cables, doors, and nonstructural walls) resulting from exposure to ambient conditions as potential aging effects.

The aging effects that result from contact of the control area ventilation SSCs to the environments described in LRA Section 2.3.3.8 and Tables 3.3-9, 3.3.10, and 3.3.11, pages 3.3-87 through 3.3-113, and in correspondence from the applicant, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.8.2.2 Aging Management Programs

LRA Section 2.3.3.8 and Tables 3.3-9, 3.3.10, and 3.3.11, pages 3.3-87 through 3.3-113, state that the following aging management programs are credited for managing the aging effects in the control area ventilation and chilled water systems:

- Fluid Leak Management Program
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components
- Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water
- Service Water Piping Corrosion Program

In its November 14, 2002, response to SER open item 2.3-3, the applicant identified the Ventilation Area Pressure Boundary Sealants Inspection to manage the effects of cracking and shrinkage of structural sealant due to exposure to ambient conditions.

The Fluid Leak Management Program, Chemistry Control Program, Service Water Piping Corrosion Program, Inspection Program for Civil Engineering Structures and Components, and Ventilation Area Pressure Boundary Sealants Inspection are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. The staff's evaluation of Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program follows.

<u>Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water Program</u>

The applicant described its Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water in Section B.3.17.4 of LRA Appendix B. The staff reviewed the LRA to determine whether the applicant had demonstrated that this program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The applicant provided a discussion of the preventive maintenance activities of the control area chilled water heat exchangers in Section B.3.17.4 of LRA Appendix B. The applicant stated that the purpose of this program is to manage fouling and loss of material of the parts of the control room area chillers exposed to raw water. This is defined by the applicant as a condition monitoring program that monitors specific component parameters to detect the presence, and assess the extent, of material loss that can affect the pressure boundary functions, and periodically cleans the chiller tubes to manage fouling. The applicant credited the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program with managing loss of material or fouling for admiralty brass, carbon steel, and stainless steel materials.

The staff's evaluation of the preventive maintenance testing activities of the control area chilled water heat exchangers program focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The applicant defined the scope of the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program to include the McGuire and Catawba control room chiller condenser tubes and channel heads. The staff finds the scope to be acceptable because it includes those components important to assuring that the pressure boundary is maintained.

[Preventive or Mitigative Actions] The applicant stated that there are no actions taken as part of this program to prevent aging effects or to mitigate aging degradation. The staff agreed that this program is designed to monitor and inspect the components and, therefore, preventive or mitigative actions are not required.

[Parameters Monitored or Inspected] The applicant stated that the program inspects the chiller tubes and channel heads to provide an indication of loss of material. The staff finds the inspection parameters to be acceptable because they will permit the applicant to receive early warning of potential loss of wall material in the tubes.

[Detection of Aging Effects] The applicant stated that in accordance with the information provided under the Monitoring and Trending section, the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program will detect loss of material due to crevice, galvanic, general, pitting, microbiologically influenced corrosion, and particle erosion prior to loss of the component's pressure boundary function. The applicant stated that the program will also manage fouling prior to the loss of the heat transfer function. The staff agreed that the program is capable of detecting loss of material to allow for corrective actions to be taken prior to the loss of function and, therefore, finds this to be acceptable.

[Monitoring and Trending] The applicant stated that the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water performs eddy current testing on the heat exchanger tubes to measure wall thickness in order to detect areas with loss of material. The applicant performs NDT on approximately 50 percent of the control room chiller condensers at least every 5 years. The applicant then performs an analysis following each NDT to determine the need for further testing, replacement, or repair.

The applicant stated that fouling of the internal portions of the chiller tubes exposed to raw water is managed by routine cleaning. At least annually, the tubes are rodded out and cleaned. No action is taken as part of this activity to trend inspection results. The applicant stated that loss of material of the channel heads is managed by an annual visual inspection of the protective coatings to assure the integrity of the underlying base metal. The channel heads of the control room area chillers are coated with a high solids epoxy. The coating inspection specifically identifies rust blooms, which indicate a coating defect and corrosion of the base metal. No action is taken as part of this activity to trend inspection results.

The staff finds that the monitoring and inspection activities are acceptable because they are capable of identifying loss of material to allow for corrective action to be taken prior to loss of component function. The applicant does not trend the results of the inspections, and the staff did not identify a need for such trending because actions are taken based on inspection findings.

[Acceptance Criteria] The applicant stated that the acceptance criteria for the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program is no unacceptable loss of material of the tubes and channel heads that could result in a loss of the component's intended function(s), as determined by engineering evaluation. The staff did not consider this an adequate acceptance criterion for the heat exchanger preventive maintenance activities AMP. The staff requested the applicant to specify parameters with quantitative limits, and this issue was characterized as SER open item 3.0.3.9.1.2(e).

In its response to SER open item 3.0.3.9.1.2(b-g), dated October 28, 2002, the applicant indicated that eddy current testing is the method used to manage loss of material of the subject heat exchanger tubes. Eddy current testing is a standard industry practice used for detecting wall loss in heat exchangers, but requires careful engineering evaluation of all test results to provide the proper management of a heat exchanger. Steam generators are the only plant heat exchangers for which station technical specifications or sets of standards exist to define the flaw depth at which a tube must be plugged and removed from service.

For the low pressure, low temperature heat exchangers to which SER open items 3.0.3.9.1.2 (b-g) apply, evaluating eddy current test results for "unacceptable loss of material" involves many variables, such as tube material, characterization of the indication in terms of percent wall loss, rate of degradation as compared to previous indications, and the frequency of subsequent testing. Criteria such as ASME Code requirements, additional inspection results, and operating experience may be used to assess the severity of the degradation and the need for corrective actions.

The applicant further explained that eddy current testing at McGuire and Catawba is performed by a vendor who specializes in the practice. A 4-step process is used to determine if test results are acceptable and to generate the final test report. This process is described in detail in the applicant's October 28, 2002, response to this SER open item. The following is the process described by the applicant:

> (1) At the conclusion of testing of a component, the vendor's eddy current testing manager reviews the data and makes a plugging recommendation in the preliminary report based on his assessment of the damage flaws and experience with testing the component. Experience demonstrates that these specialists generally recommend evaluation at around a 70 percent wall loss range.
>
> (2) Duke then reviews the entire test data provided in the preliminary test report, including the recommendation for plugging, prior to returning the component to service. Duke evaluates the recommendations using all the information they have available. Particularly, Duke evaluates the rate of degradation based on the history of the tube. The wall loss may be deemed acceptable if the tube is showing minimal to no degradation from previous inspections. Consideration is also given to the frequency of the next inspection; if frequent inspection is performed, then a higher wall loss range may be acceptable and if less frequent inspection is performed then lower wall loss range may be unacceptable.
>
> (3) Depending on the type of tubing material and tubing damage detected with eddy current testing and possibly verified with actual tube pulled samples, a wall loss correlation may be determined as a threshold for evaluating the tube for plugging repair. Past operating experience with the type of tubing flaw may also be a very useful factor in determining the wall loss plugging threshold.
>
> (4) The loss of material experienced by these heat exchanger tubes generally manifests itself as pits. These pitting flaws are not very likely to fail heat exchanger tubing due to mechanical stress of pressure and temperature due to the shouldered nature or material reinforcement around pits. Therefore, the pitting rate as determined from past eddy current testing experience becomes the primary factor to consider when selecting tubes to remove from service to prevent later on-line tube leaks.

The applicant further stated that its experience in evaluating eddy current testing results has proven to be effective during the operation of McGuire and Catawba. Corrective actions such as tube plugging and tube bundle and heat exchanger replacement have been taken as a result of failed acceptance criteria of the subject programs. On the basis of the information provided in the applicant's October 28, 2002, open item response, the staff finds that appropriate and adequate acceptance criteria for detecting heat exchanger tube degradation from loss of material are identified for these aging management programs. Therefore, open items 3.0.3.9.1.2(b-g) are closed.

[Operating Experience] The applicant stated that operating experience associated with the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program has demonstrated that the eddy current testing provides adequate information on the extent of wall loss present in the chiller tubes to predict when corrective action is required. Corrective action, in the form of tube plugging, for example, is performed before the loss of component intended function.

The applicant stated that periodic tube cleaning has proven to be an effective method of managing fouling of the tubes that could lead to loss of heat transfer. The applicant stated that the control area chiller operates during normal plant operation. The applicant's routine surveillance of the chiller's operating parameters indicated that periodic cleaning is effective in managing fouling of the chiller tubes. The applicant stated that experience prior to the application of the coatings of the carbon steel channel heads indicated that loss of material was occurring. Due to the inspection results, the applicant recently coated the channel heads. Future inspection of the coatings should allow the applicant to ensure that the protective features of the coatings are maintained intact.

The applicant's operating experience has demonstrated that Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program is an effective program for managing the effects of aging. The program with its proven monitoring techniques, acceptance criteria, corrective actions, and administrative controls, accurately predicts aging effects due to corrosion and erosion.

The staff finds that the applicant is properly making use of the operating experience with the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program, and has demonstrated the ability of the program to properly manage aging effects of the chiller tubes.

FSAR Supplement: In LRA Appendix A-1, Section 18.2.13.4, and LRA Appendix A-2, Section 18.2.12.4, the applicant provided proposed FSAR supplements for McGuire and Catawba, respectively. The staff reviewed this information and found it to be consistent with the information provided in Appendix B, Section B.3.17.4 and is, therefore, acceptable.

During its review of information in Section 2.3.3.8; Tables 3.3-9, 3.3-10, and 3.3-11, pages 3.3-87 through 3.3-113; and Section B.3.17.4 of LRA Appendix B, the staff identified the need for additional information pertaining to this AMP. In Tables 3.3-9 and 3.3-10 of the LRA, the applicant indicates that the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program is credited for managing the aging effects of fouling and loss of material for copper-nickel alloy materials. The Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program, as defined in Appendix B of the LRA, manages the loss of material or fouling for admiralty brass, carbon steel, and stainless steel materials, but the description in Appendix B does not include the copper-nickel material in the scope of the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program. By letter dated January 23, 2002, the staff requested, in RAI 3.3.9-1, that the applicant explain how the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program manages the loss of material or fouling for copper-nickel alloy materials, or provide an AMP for managing these aging effects for this material.

In its response dated March 15, 2002, the applicant stated that the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program, as described in Section B.3.17.4 of LRA Appendix B, is credited for managing fouling and loss of material for the copper-nickel alloy tubes. The copper-nickel alloy material was inadvertently omitted from the introductory paragraph in the program description in Appendix B of the application. The program description does describe how fouling and loss of material of the copper-nickel alloy heat exchanger tubes are managed. The applicant further stated that Section 18.2.13.4 of the McGuire FSAR supplement, and Section 18.2.12.4 of the Catawba FSAR supplement, will be revised to indicate that the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program is credited for managing loss of material or fouling for admiralty brass, carbon steel, copper-nickel alloy, and stainless steel materials. Since the applicant's AMP manages fouling and loss of material of copper-nickel alloy components, and the applicant has added copper-nickel alloy components to the AMP description in the FSAR supplements, the staff finds that the applicant's response clarifies and satisfactorily resolves this item.

The staff has reviewed the information in Section B.3.17.4 of LRA Appendix B. On the basis of this review and the above evaluation, and with the resolution of SER open item 3.0.3.9.1.2(e), the staff finds that the applicant has demonstrated that the effects of aging associated with the Heat Exchanger Preventive Maintenance Activities — Control Area Chilled Water program will be adequately managed, so that there is reasonable assurance 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).

Based on its review of Tables 3.3-9, 3.3-10, and 3.3-11, and LRA Appendix B, as well as correspondence from the applicant, the staff concludes that the above identified AMPs will effectively manage the aging effects of the control area ventilation and chilled water systems, and that there is reasonable assurance that the intended functions of these systems will remain consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.8.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.8, Tables 3.3-9, 3.3-10 and 3.3-11, and Section B.3.17 of LRA Appendix B. The staff also reviewed information provided in correspondence from the applicant. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the control area ventilation and chilled water systems will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.9 Conventional Wastewater Treatment System

3.3.9.1 Technical Information in the Application

The McGuire conventional wastewater treatment system maintains water level in the standby shutdown facility (SSF) sump to prevent flooding of the SSF equipment. The McGuire UFSAR provides a more detailed description in Section 9.2.8.

3.3.9.1.1 Aging Effects

Components of the conventional wastewater treatment system are described in Section 2.3.3.9 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-12, pages 3.3-114 through 3.3-115, lists individual components of the system, including pipe, pump casings, and valve bodies. Internal surfaces of carbon steel and cast iron components exposed to a raw water environment are subject to the aging effect of loss of material. External surfaces of carbon steel and cast iron components exposed to sheltered environments also are subject to the aging effect of loss of material. Embedded carbon steel components experience no aging effects.

3.3.9.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the conventional wastewater treatment system:

- Galvanic Susceptibility Inspection
- Sump Pump System Inspection
- Inspection Program for Civil Engineering Structures and Components
- Selective Leaching Inspection

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the conventional wastewater treatment system will be adequately managed by these aging management programs during the period of extended operation.

3.3.9.2 Staff Evaluation

The applicant described its AMR of the conventional wastewater treatment system for license renewal in two separate sections of its LRA, Section 2.3.3.9 and Table 3.3-12, pages 3.3-114 through 3.3-115. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the conventional wastewater treatment system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.9.2.1 Aging Effects

The aging effects that result from contact of the conventional wastewater treatment SSCs to the environments described in LRA Section 2.3.3.9 and Table 3.3-12, pages 3.3-114 through 3.3-115, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.9.2.2 Aging Management Programs

LRA Section 2.3.3.9 and Table 3.3-12, pages 3.3-114 through 3.3-115, state that the following aging management programs are credited for managing the aging effects in the conventional wastewater treatment system:

- Galvanic Susceptibility Inspection
- Sump Pump System Inspection
- Inspection Program for Civil Engineering Structures and Components
- Selective Leaching Inspection

The Galvanic Susceptibility Inspection Program, Sump Pump System Inspection Program, Inspection Program for Civil Engineering Structures and Components, and Selective Leaching

Inspection Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-12, the staff concludes that the above identified AMPs will effectively manage the aging effects of the conventional wastewater treatment system, and that there is reasonable assurance that the intended functions of the conventional wastewater treatment system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.9.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.9 and Table 3.3-12, pages 3.3-114 through 3.3-115. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the conventional wastewater treatment system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.10 Diesel Building Ventilation System

3.3.10.1 Technical Information in the Application

The diesel building ventilation system maintains temperature control for each diesel building when its associated diesel generator is running. The McGuire and Catawba UFSARs provide more detailed descriptions in Sections 9.4.6 and 9.4.4, respectively.

3.3.10.1.1 Aging Effects

Components of the diesel building ventilation system are described in Section 2.3.3.10 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-13, pages 3.3-116 through 3.3-117, lists individual components of the system, including pipe, tubing, ductwork, and valve bodies. External surfaces of carbon steel components are subject to the aging effect of loss of material from exposure to sheltered environments. Internal and external surfaces of stainless steel, brass, galvanized steel and copper components exposed to ventilation and sheltered environments are not subject to any aging effects because there is no potential for boric acid contamination of components in this building.

3.3.10.1.2 Aging Management Programs

The Inspection Program for Civil Engineering Structures and Components is utilized to manage aging effects for the diesel building ventilation system. A description of the aging management program is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the diesel building ventilation system will be adequately managed by the aging management program during the period of extended operation.

3.3.10.2 Staff Evaluation

The applicant described its AMR of the diesel building ventilation system for license renewal in two separate sections of its LRA, Section 2.3.3.10 and Tables 3.3-13, pages 3.3-116 through 3.3-117. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging on the diesel building ventilation system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.10.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.10 and Table 3.3-13, pages 3.3-116 through 3.3-117. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff asked, in RAI 3.3-1, the applicant to indicate why AMR results tables for numerous ventilation systems in LRA Section 3.3 do not list elastomer components associated with duct seals, flexible collars between ducts and fans, rubber boots, etc. The staff's evaluation of the applicant's April 15, 2002, response to RAI 3.3-1, pertaining to aging of ventilation system flexible connectors, is documented in Section 3.3.39.3 of this SER, and is characterized as resolved.

The aging effects that result from contact of the diesel building ventilation SSCs to the environments described in LRA Section 2.3.3.10 and Table 3.3-13, pages 3.3-116 through 3.3-117, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.10.2.2 Aging Management Programs

LRA Section 2.3.3.10 and Tables 3.3-13, pages 3.3-116 through 3.3-117, state that the Inspection Program for Civil Engineering Structures and Components is credited for managing the aging effects in the diesel building ventilation system. The Inspection Program for Civil Engineering Structures and Components is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common aging management program. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-13, the staff concludes that the above identified AMP will effectively manage the aging effects of the diesel building ventilation system, and that there is reasonable assurance that the intended functions of the diesel building ventilation system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.10.3 Conclusions

The staff reviewed the information in Section 2.3.3.10 and Table 3.3-13 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the diesel building ventilation system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.11 Diesel Generator Air Intake and Exhaust System

3.3.11.1 Technical Information in the Application

The diesel generator air intake and exhaust system is essentially the same, and performs the same function, for McGuire and Catawba. The diesel generator air intake and exhaust system supplies sufficient air to the diesel generator engines for fuel consumption, and removes exhaust from the diesel generator engines to the atmosphere outside the building. McGuire UFSAR Section 9.5.11, "Diesel Generator Air Intake and Exhaust System," provides additional information concerning the McGuire diesel generator air intake and exhaust system. Catawba UFSAR Section 9.5.8, "Diesel Generator Air Intake and Exhaust System," provides additional information concerning the Catawba diesel generator air intake and exhaust system.

3.3.11.1.1 Aging Effects

Components of the diesel generator air intake and exhaust system are described in Section 2.3.3.11 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-14, pages 3.3-118 through 3.3-120, lists individual components of the system, including exhaust silencers, filters, flexible connectors, expansion joints, hoses, tubing, pipes, and valve bodies. Stainless steel components are identified as being subject to an internal ventilation environment and an external sheltered environment with no aging effects identified. Carbon steel components are subject to the aging effect of loss of material from external surfaces from sheltered and yard environments. Carbon steel components are identified as being subject to the internal environment of ventilation with no aging effects identified. Rubber and composite rubber components exposed to internal ventilation environment and an external sheltered environment have no identified aging effects.

3.3.11.1.2 Aging Management Programs

The Inspection Program for Civil Engineering Structures and Components is utilized to manage aging effects for the diesel generator air intake and exhaust system. A description of the aging management program is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the diesel generator air intake and exhaust system will be adequately managed by the aging management program during the period of extended operation.

3.3.11.2 Staff Evaluation

The applicant described its AMR of the diesel generator air intake and exhaust system for license renewal in two separate sections of its LRA, Section 2.3.3.11 and Table 3.3-14, pages 3.3-118 through 3.3-120. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the diesel generator air intake and exhaust system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.11.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.11 and Table 3.3-14, pages 3.3-118 through 3.3-120. During its review, the staff determined that additional information was needed to complete its review and, on January 23, 2002, issued RAIs 3.3-5, 3.3.14-1, and 3.3.14-2. The staff's evaluation of the applicant's responses is provided below.

In the LRA, the applicant stated that all of the components in Table 3.3-14, "Aging Management Review for Diesel Generator Air Intake and Exhaust System," are subject to an interior environment of ventilation, which is defined as ambient air that is conditioned to maintain a suitable environment for equipment operation and personnel occupancy. CN-1609-5.0, CN-2609-5.0, MCFD-1609-5.00 and MCFD-2609-5.00, "Flow Diagrams for Diesel Engine Air Intake and Exhaust System," do not include equipment to condition the intake air or the exhaust air for the diesels to provide a ventilation internal environment. Typically, these components are subject to a sheltered internal environment. Similarly, Table 3.3-44, "Aging Management Review Results — Standby Shutdown Diesel Generator, Exhaust Sub-System," components are subject to an internal environment of ventilation, which is defined as ambient air that is conditioned to maintain a suitable environment for equipment operation and personnel occupancy. CN-1560-1.0, CN-1560.20, MCFD-1560-1.00, MCFD-1560.20, and MCFD-1614-4, "Flow Diagrams for Standby Shutdown Diesel System," do not include equipment to condition the intake air or the exhaust air for the diesels to provide a ventilation internal environment. Typically, these components are subject to a sheltered internal environment. In RAI 3.3-5, the staff requested that the applicant provide justification for classifying the internal environment for these components as "ventilation."

In its response to RAI 3.3-5, dated March 15, 2002, the applicant stated that the staff is correct that these components are subject to a sheltered internal environment. Duke's aging management review conservatively evaluated environments, such as tanks and piping, that are open to atmosphere as a ventilation environment. Although the tanks and piping are open to sheltered environments, they would not experience significant air exchange, and thus higher humidity and condensation could be present. The ventilation environment aging effect details account for the potential condensation, whereas the sheltered environment aging effect details do not. Loss of material and cracking due to alternate wetting and drying that concentrates contaminants are two aging effects considered plausible in a ventilation environment, but are not considered in sheltered environments. Loss of material due to selective leaching is another aging effect considered plausible in a ventilation environment, but is not considered in sheltered environments. Therefore, for conservatism, Duke chose to evaluate these component configurations using the ventilation environment aging management review details. The designation in the LRA table reflects this decision.

In electronic correspondence dated May 2, 2002 (ADAMS Accession No. ML021440217), the staff requested additional justification for the applicant's statement in Table 3.3-14 that carbon steel external components are subject to a sheltered environment, while the internal environment is ventilation. The sheltered environment is subject to the aging effect of loss of material and is managed by the Inspection Program for Civil Engineering Structures and Components. This appeared to the staff to conflict with Duke's RAI response, which states that loss of material in sheltered environments is not considered an aging effect. The staff requested that the applicant clarify or justify how an "uncontrolled" sheltered environment is less conservative than a "controlled" ventilation environment and causes no aging effects, or revise the aging effects and AMPs listed in Table 3.3-14 to be consistent with other sheltered environments listed in the tables. The staff further noted that its fundamental concern was that, for the diesel engine exhaust systems (which include no equipment (coolers or dryers) for controlling air quality), the internal environments are "sheltered," not "ventilation," and that the aging effects associated with the sheltered environment must be addressed for these internal surfaces.

In electronic correspondence dated May 10, 2002 (ADAMS Accession No. ML021440236), the applicant replied as follows—

> For Duke, a sheltered environment is an external environment for components inside a structure that may or may not be maintained by a ventilation system but are protected from the natural elements. Components in a sheltered environment could be wet from condensation or leakage that could promote aggressive corrosion, that left unmanaged, could result in a loss of the component intended function(s) during the period of extended operation. As such, the Inspection Program for Civil Engineering Structures and Components is credited to manage the aging effects on the external surfaces of components located in a sheltered environment.
>
> For components with an internal air environment open to the sheltered environment or yard environment (as is the case with the diesel exhaust), Duke classified the environment as a ventilation environment. Duke conservatively chose the ventilation environment because more aging mechanisms leading to aging effects are plausible and must be considered than in a sheltered environment. In our initial response to RAI 3.3-5, Duke tried to show that aging effects from some mechanisms are not plausible in a sheltered environment but could occur in a ventilation environment. Duke was providing examples to support our conservative position which we believe does not say that loss of material in a sheltered environment is not an aging effect.
>
> Duke evaluated the internal environment of the exhaust systems as a ventilation environment. The diesels operate periodically for short periods of time for testing but are primarily in standby. The internal environment is characterized as a warm, dry environment free from leaks and condensation. This environment does not preclude loss of material but does not promote the aggressive corrosion that left unmanaged would result in a loss of the component intended function(s) of the exhaust system components. Therefore, no aging effects requiring management during the period of extended operation were identified.

By letter dated July 9, 2002, the staff received this information from the applicant in official correspondence. The applicant confirmed that the internal environment is warm, dry, and free from leaks and condensation. Since this environment does not promote the aggressive corrosion that would result in a loss of the component intended function(s) of the exhaust system components, this issue is resolved.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.14-1, additional information pertaining to Table 3.3-14 of the LRA, "Aging Management Review for Diesel Generator Air Intake and Exhaust System." This table does not list an internal environment of hot diesel engine exhaust gasses containing moisture and particulates. By letter dated January 23, 2002, the staff requested the applicant to identify where in the LRA the AMR results are for steel components exposed to a hot diesel exhaust environment that have the potential for experiencing loss of material from general, pitting and crevice corrosion, or to provide a justification for excluding this environment and aging effects from Table 3.3-14 and an AMR.

In its response dated March 15, 2002, the applicant stated that Table 3.3-14 of the LRA presents the results of the aging management review for the diesel generator intake and exhaust system components. The diesel generators are normally in standby and are operated periodically for a short period of time for surveillance testing. During diesel operation, the exhaust portion of this system will be exposed to hot gasses containing moisture and particulates. Exposure duration of the exhaust components to the hot gasses containing moisture and particulates is insignificant when compared to the exposure time of these components to the cool, ventilation environment. As a result, the internal environment of hot gasses containing moisture and particulates was not considered in the aging management review to identify the aging effects requiring management. Therefore, Table 3.3-14 listed ventilation as the internal environment and did not include hot gasses as an internal environment. The staff finds that the applicant's response provides a reasonable explanation of why the environment is ventilation rather than exhaust. Since the standby diesel generators only test run periodically, the staff agrees that the subject exhaust components will not be exposed to the hot gasses containing moisture and particulates.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.14-2, additional information pertaining to information provided in Table 3.5-2 of the LRA, "Aging Management Review Results for Other Structures." This table indicates that rubber materials in sheltered environments are subject to the aging effects of cracking and change in material properties. The staff requested that the applicant explain why the rubber and composite rubber materials of Table 3.3-14, that are also in sheltered environments, are not subject to the aging effects of cracking and change in material properties.

In its response dated March 15, 2002, the applicant stated that elastomers could crack due to exposure to ultraviolet radiation, ozone, elevated temperature, or irradiation. Elastomers could experience a change in material properties due to exposure to elevated temperatures or irradiation. Damaging levels of radiation, temperature, and ozone are not present throughout the entire sheltered environment. As a result, elastomer location must be considered to identify the aging effects requiring management. The elastomers in Table 3.3-14 of the LRA are located in the diesel room. Radiation, temperature, and ozone are below the levels to be a concern in this location. Therefore, no aging effects requiring management were identified for these elastomers. Since the applicant indicated that these elastomers are located in an area where radiation and temperature are not significant enough to cause degradation, the staff finds the response acceptable.

The staff finds that the applicant's responses to RAIs 3.3.14-1 and 3.3.14-2 clarify and satisfactorily resolve these items. The aging effects that result from contact of diesel generator air intake and exhaust SSCs to the environments described in LRA Section 2.3.3.11 and Table 3.3-14, pages 3.3-118 through 3.3-120, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.11.2.2 Aging Management Programs

LRA Section 2.3.3.11 and Table 3.3-14, pages 3.3-118 through 3.3-120, state that the Inspection Program for Civil Engineering Structures and Components is credited for managing the aging effects in the diesel generator air intake and exhaust system. The Inspection Program for Civil Engineering Structures and Components is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common aging management program. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-14, the staff concludes that the above identified AMP will effectively manage the aging effects of the diesel generator air intake and exhaust system, and that there is reasonable assurance that the intended functions of the diesel generator air intake and exhaust system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.11.3 Conclusions

The staff reviewed the information in Section 2.3.3.11 and Table 3.3-14 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the diesel generator air intake and exhaust system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.12 Diesel Generator Cooling Water System

3.3.12.1 Technical Information in the Application

The diesel generator cooling water system is essentially the same, and performs the same function, for McGuire and Catawba. The diesel generator cooling water system maintains the temperature of each emergency diesel generator engine, and support systems, within a required operating range. McGuire UFSAR Section 9.5.5, "Diesel Generator Cooling Water System," provides additional information concerning the McGuire diesel generator cooling water system. Catawba UFSAR Section 9.5.5, "Diesel Generator Engine Cooling Water," provides additional information concerning the Catawba diesel generator engine cooling water system.

3.3.12.1.1 Aging Effects

Components of the diesel generator cooling water system are described in Section 2.3.3.12 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Tables 3.3-15 and 3.3-16, pages 3.3-121 through 3.3-130, list individual components of the system, including the annubars, tanks, heat exchanger, intercoolers, pumps, heaters, flow orifices, piping, tubing, lube oil coolers, stand pipes, and valve bodies. Stainless steel components are identified as being subject to cracking and loss of material from exposure to the internal environment of treated water. Exposure of stainless steel to sheltered environment has no aging effects. Carbon steel components are subject to the aging effect of loss of material from internal surfaces from treated water and raw water environments. Internal surfaces of carbon steel components are also subject to cracking from exposure to treated water environments. Carbon steel is also subject to an aging effect of loss of material to external surfaces from exposure to sheltered environments. Exposure of internal surfaces of carbon steel components to a ventilation environment has no aging effect, except for the diesel generator cooling water surge tanks at McGuire and the jacket water standpipes at Catawba.

Copper components are exposed to an internal and external environment of ventilation with no aging effects identified. Copper components exposed to an internal and external environment of raw water and treated water are subject to the aging effects of fouling and loss of material. Cast iron components exposed to treated water and sheltered environments are subject to loss of material from internal and external surfaces. Brass components exposed to internal and external environments of raw water and treated water are subject to the aging effects of fouling and loss of material. Internal surfaces of aluminum components exposed to treated water are subject to cracking and loss of material. Aluminum and brass exposed to oil or sheltered environments demonstrate no aging effects.

3.3.12.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the diesel generator cooling water system:

- Galvanic Susceptibility Program
- Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components
- Performance Test Activities — Diesel Engine Cooling Water Exchanger
- Service Water Piping Corrosion Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the diesel generator cooling water system will be adequately managed by these aging management programs during the period of extended operation.

3.3.12.2 Staff Evaluation

The applicant described its AMR of the diesel generator cooling water system for license renewal in two separate sections of its LRA, Section 2.3.3.12 and Tables 3.3-15 and 3.3-16, pages 3.3-121 through 3.3-130. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the diesel generator cooling water system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.12.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.12 and Tables 3.3-15 and 3.3-16, pages 3.3-121 through 3.3-130. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3-3, additional information pertaining to LRA Tables 3.3-16, 3.3-20, and 3.3-21. According to Table 3.3-16, the Catawba diesel generator governor lube oil coolers (tubes) are subject to an internal/external environment of treated water/oil. Similarly, LRA Tables 3.3-20 and 3.3-21 indicate that the diesel generator engine lube oil coolers (tubes, tubesheets, and/or shells) are listed as subject to an internal/external environment of treated water/oil. The staff requested the applicant to identify where in the LRA the aging effect of loss of material for these components in oil systems subject to water contamination was addressed.

In its response dated March 15, 2002, the applicant stated that all of the lube oil cooler components cited in the first paragraph of RAI 3.3-3 are components of closed oil recirculation systems. Uncontaminated lube oil does not cause aging, and closed oil recirculation systems are assumed to be initially free of contaminants, such as water. Further, in the Duke aging management review, component failures were not postulated as a means to establish the relevant conditions required for aging to occur. Therefore, in oil coolers, tube failures that could introduce water into a lube oil environment are not assumed. The staff agrees that uncontaminated oil will not cause any aging effect to the components, and that the applicant is not required to assume a failure that can cause an aging effect. The staff finds that the applicant's response to RAI 3.3-3 clarifies and satisfactorily resolves this item.

The aging effects that result from contact of the diesel generator cooling water SSCs to the environments described in LRA Section 2.3.3.12 and Tables 3.3-15 and 3.3-16, pages 3.3-121 through 3.3-130, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.12.2.2 Aging Management Programs

LRA Section 2.3.3.12 and Tables 3.3-15 and 3.3-16, pages 3.3-121 through 3.3-130, state that the following aging management programs are credited for managing the aging effects in the diesel generator cooling water system.

- Galvanic Susceptibility Program
- Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water
- Chemistry Control Program
- Inspection Program for Civil Engineering Structures and Components
- Performance Test Activities — Diesel Generator Engine Cooling Water Heat Exchangers
- Service Water Piping Corrosion Program

The Galvanic Susceptibility Inspection Program, Chemistry Control Program, Inspection Program for Civil Engineering Structures and Components, and Service Water Piping Corrosion Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. The staff's evaluation of the Performance Test Activities — Diesel Generator Engine Cooling Water Heat Exchangers program and Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water program follows.

<u>Performance Testing Activities — Diesel Generator Engine Cooling Water Heat Exchangers</u>

The applicant described its Performance Test Activities — Diesel Generator Engine Cooling Water Heat Exchangers in Section B.3.17.3.1 of LRA Appendix B. The staff reviewed the LRA to determine whether the applicant had demonstrated that this program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The applicant stated that the purpose of the Performance Test Activities — Diesel Generator Engine Cooling Water Heat Exchangers is to manage fouling of copper and brass heat exchanger tubes that are exposed to raw water. This is considered by the applicant to be a performance monitoring program that monitors specific component parameters to detect the presence of fouling, which can affect the heat transfer function of the component.

The staff's evaluation of the Performance Test Activities — Diesel Generator Engine Cooling Water Heat Exchangers program focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The scope of the Performance Test Activities — Diesel Generator Engine Cooling Water Heat Exchangers includes the tubes of the following components:

- diesel generator engine cooling water heat exchangers (McGuire only)
- diesel generator engine jacket water coolers (Catawba only)

The applicant noted that these components serve the same function at both plants, but have different names because of the different diesel suppliers.

The staff finds the scope of the program to be acceptable because it covers components important to the system function, and will allow identification of fouling which can affect the heat transfer function of the component.

[Preventive or Mitigative Actions] The applicant stated that no actions are taken as part of this program to prevent aging effects or to mitigate aging degradation. The staff agrees with the applicant because the purpose of the program is to detect and assess the extent of material loss, not to prevent such loss.

[Parameters Monitored or Inspected] The applicant stated that at McGuire, the Performance Test Activities — Diesel Generator Engine Cooling Water Heat Exchangers involve monitoring of flow capacity by performance of a differential pressure test to provide an indication of fouling. At Catawba, the performance testing activities involve monitoring of the heat transfer capability by performance of a heat capacity test to provide an indication of fouling. The staff finds the parameters monitored to be acceptable because they are typical of industry practice for determining fouling in heat exchanger tubes. The different methods used at the two plants are both acceptable methods of testing.

[Detection of Aging Effects] The applicant stated that in accordance with the information provided under Monitoring and Trending, the performance testing activities will detect fouling prior to loss of the component intended function(s). The staff finds the applicant's approach acceptable because it is based on standard industry-approved methods.

[Monitoring and Trending] The applicant stated that, due to different system design features at McGuire and Catawba, different parameters are monitored to manage fouling of the heat exchanger tubes. At McGuire, the performance testing activities involve measurement of the differential pressure across the raw water side of the heat exchangers every 6 months. Differential pressure provides a direct indication of fouling of the heat exchanger tubes. At Catawba, a heat capacity test computes a tube side fouling factor using tube and shell side inlet and outlet temperatures and flow rates every 6 months. Heat capacity provides a direct indication of fouling of the heat exchanger tubes. The staff finds that the monitoring and trending methods used, although different at the two plants, rely on standard engineering methods which are equally capable of detecting fouling in the heat exchanger tubes. Because the monitoring methods will allow the applicant to detect and correct fouling before it results in loss of cooling function, the staff finds the monitoring activities to be acceptable.

[Acceptance Criteria] The applicant stated that at McGuire, the acceptance criterion for the performance testing activities is the established differential pressure value that ensures fouling does not prevent the heat exchangers from performing their design basis function. At Catawba, the applicant stated that the acceptance criteria for the performance testing activities are established by engineering calculation, and the comparison of the test results to the acceptance criteria ensures fouling does not prevent the heat exchangers from performing their design basis function. The staff finds the acceptance criteria for both plants to be acceptable because the testing methods will detect degradation of the heat exchangers, and will allow corrective action to be taken before fouling can result in loss of the design function.

[Operating Experience] The applicant stated that operating experience associated with the performance testing activities has demonstrated that the fouling factor and the tube side differential pressure provide adequate indications to predict when corrective action is required for heat transfer surface fouling. Corrective action, in the form of tube cleaning, for example, is performed before the heat transfer function of the heat exchanger tubes is degraded below its required capacity. The applicant stated that with relatively low in-service duration and good valve isolation, the diesel generator engine cooling water heat exchangers usually do not accumulate large amounts of fouling materials on internal tubing surfaces.

The applicant's measurement and trending of the heat exchanger tubes using NDT provides an accurate indication of material condition. The frequency of monitoring permits the results to be trended in order to determine when corrective action is required. Based on the review of the applicant's operating experience, the staff finds that the inspections and monitoring activities have demonstrated that the techniques being used allow for the trending of the loss of material, and any required corrective actions to be performed before the loss of component intended function.

FSAR Supplement: In LRA Appendix A-1, Section 18.2.13.3, and LRA Appendix A-2, Section 18.2.12.3, the applicant has provided proposed FSAR supplements for McGuire and Catawba, respectively. The staff reviewed this information and found it to be consistent with the information provided in Appendix B, Section B.3.17.3.1 and is, therefore, acceptable.

In conclusion, the staff has reviewed the information in Section B.3.17.3.1 of the LRA. On the basis of this review and the above evaluation, the staff finds that there is reasonable assurance that the applicant has demonstrated that the effects of aging associated with the Performance Testing Activities — Diesel Generator Engine Cooling Water Heat Exchangers program 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).

Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water

The applicant described its Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water in Section B.3.17.3.2 of LRA Appendix B. The staff reviewed the LRA to determine whether the applicant had demonstrated that this program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The applicant stated that the purpose of the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water is to manage the loss of material for the parts of the diesel generator engine cooling water heat exchangers exposed to raw water. The Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water is a condition monitoring program that monitors specific component parameters to detect the presence, and assess the extent, of material loss that can affect the pressure boundary function. The applicant credited the program with managing the subject aging effects for brass and copper heat exchanger tubes.

The staff's evaluation of the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water program focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The applicant defined the scope of the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water as the tubes of the following components:

- diesel generator engine cooling water heat exchangers (Mcguire only)
- diesel generator engine jacket water coolers (Catawba only)

The applicant noted that these components serve the same function at both plants, but have different names because of the different diesel suppliers.

The staff noted that the applicant relies on other aging management programs, such as the Chemistry Control Program, to manage the aging effects of the heat exchanger shell, channel head, and tubesheets. The staff finds the scope to be acceptable because it includes those components important to assuring that the pressure boundary is maintained.

[Preventive or Mitigative Actions] The applicant stated that no actions are taken as part of this program to prevent aging effects or to mitigate aging degradation. The staff agrees with the applicant because the purpose of the program is to detect and assess the extent of material loss, not to prevent such loss.

[Parameters Monitored or Inspected] The Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water program consists of the inspection of the heat exchanger tubes that will provide an indication of loss of material. The staff finds the applicant's approach acceptable because the inspections will identify areas affected by corrosion or erosion, and provide an opportunity to take corrective actions prior to loss of pressure boundary integrity.

[Detection of Aging Effects] The applicant stated that the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water inspections will detect loss of material due to crevice, general, pitting, microbiologically influenced corrosion, and loss of material due to particle erosion prior to loss of the component intended function. The staff finds this acceptable because the inspection methods used have been demonstrated to be capable of identifying the corrosion and erosion effects that are relied on as indications of tube wall thinning.

[Monitoring and Trending] The applicant stated that the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water program performs eddy current testing on the heat exchanger tubes to measure wall thickness in order to detect areas with loss of material. Trending is performed in order to predict a heat exchanger replacement or repair schedule. The applicant stated that NDT (eddy current) is performed on approximately 50 percent of the tubes of each heat exchanger, as determined by routine differential pressure testing, based on operating experience and engineering evaluation of the test data. The staff finds this acceptable because eddy current testing is a standard method used in the industry for this type of inspection. The staff agrees that by trending the test data and use of operating experience, the applicant will be able to schedule replacement or repair prior to loss of component function.

[Acceptance Criteria] The applicant stated that the acceptance criterion for the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water program is no unacceptable loss of material of the tubes that could result in a loss of the component intended function, as determined by engineering evaluation. The staff did not consider this an adequate acceptance criterion for the heat exchanger preventive maintenance activities AMP. In addressing the acceptance criteria, the staff requested the applicant to specify parameters with quantitative limits, and this issue was characterized as SER open item 3.0.3.9.1.2(f).

In its response to SER open item 3.0.3.9.1.2(b-g), dated October 28, 2002, the applicant indicated that eddy current testing is the method used to manage loss of material of the subject heat exchanger tubes. Eddy current testing is a standard industry practice used for detecting wall loss in heat exchangers, but requires careful engineering evaluation of all test results to provide the proper management of a heat exchanger. Steam generators are the only plant heat exchangers for which station technical specifications or sets of standards exist to define the flaw depth at which a tube must be plugged and removed from service.

For the low pressure, low temperature heat exchangers to which SER open items 3.0.3.9.1.2 (b-g) apply, evaluating eddy current test results for "unacceptable loss of material" involves many variables, such as tube material, characterization of the indication in terms of percent wall loss, rate of degradation as compared to previous indications, and the frequency of subsequent testing. Criteria such as ASME Code requirements, additional inspection results, and operating experience may be used to assess the severity of the degradation and the need for corrective actions.

The applicant further explained that eddy current testing at McGuire and Catawba is performed by a vendor who specializes in the practice. A 4-step process is used to determine if test results are acceptable and to generate the final test report. This process is described in detail in the applicant's October 28, 2002, response to this SER open item. The following is the process described by the applicant:

> (1) At the conclusion of testing of a component, the vendor's eddy current testing manager reviews the data and makes a plugging recommendation in the preliminary report based on his assessment of the damage flaws and experience with testing the component. Experience demonstrates that these specialists generally recommend evaluation at around a 70 percent wall loss range.
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> (2) Duke then reviews the entire test data provided in the preliminary test report, including the recommendation for plugging, prior to returning the component to service. Duke evaluates the recommendations using all the information they have available. Particularly, Duke evaluates the rate of degradation based on the history of the tube. The wall loss may be deemed acceptable if the tube is showing minimal to no degradation from previous inspections. Consideration is also given to the frequency of the next inspection; if frequent inspection is performed, then a higher wall loss range may be acceptable and if less frequent inspection is performed then lower wall loss range may be unacceptable.
>
> (3) Depending on the type of tubing material and tubing damage detected with eddy current testing and possibly verified with actual tube pulled samples, a wall loss correlation may be determined as a threshold for evaluating the tube for plugging repair. Past operating experience with the type of tubing flaw may also be a very useful factor in determining the wall loss plugging threshold.
>
> (4) The loss of material experienced by these heat exchanger tubes generally manifests itself as pits. These pitting flaws are not very likely to fail heat exchanger tubing due to mechanical stress of pressure and temperature due to the shouldered nature or material reinforcement around pits. Therefore, the pitting rate as determined from past eddy current testing experience becomes the primary factor to consider when selecting tubes to remove from service to prevent later on-line tube leaks.

The applicant further stated that its experience in evaluating eddy current testing results has proven to be effective during the operation of McGuire and Catawba. Corrective actions, such as tube plugging and tube bundle and heat exchanger replacement, have been taken as a result of failed acceptance criteria of the subject programs. On the basis of the information provided in the applicant's October 28, 2002, open item response, the staff finds that appropriate and adequate acceptance criteria for detecting heat exchanger tube degradation from loss of material are identified for these aging management programs. Therefore, open items 3.0.3.9.1.2(b-g) are closed.

[Operating Experience] The applicant stated that the operating experience associated with the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water program has demonstrated that the eddy current testing provides adequate information in regards to the presence of wall loss in the heat exchanger tubes to predict when corrective action is required. Corrective action in the form of tube plugging, for example, is performed before the loss of the component's intended function.

Due to operating experience at Catawba, the applicant stated that the frequency of eddy current testing had been increased at both sites. During 1992 and 1993, the Catawba 2 diesel generator engine cooling water heat exchangers experienced circumferential cracking of the tubes. Complete tube severance occurred on several tubes. The investigation by the applicant revealed that the Catawba 2 heat exchangers were set up on a weekly nuclear service water system flush schedule (whereas Catawba 1 heat exchangers were not). Circumferential cracks were determined to be linked to the thermal shock received during the nuclear service water flushes. The applicant discontinued the flushes and a special eddy current test probe was employed to determine the extent of circumferential cracking defects. Repairs were in the form of plugging and re-tubing.

The applicant's operating experience has demonstrated that the diesel generator engine cooling water heat exchanger activities program is an effective program for managing the effects of aging. The program with its proven monitoring techniques, acceptance criteria, and corrective actions accurately predicts aging effects due to erosion and corrosion. Therefore, the staff finds that the applicant is effectively applying the operating experience at their sites to improve the preventive maintenance activities related to the diesel generator engine cooling water system.

FSAR Supplement: In LRA Appendix A-1, Section 18.2.13.3, and LRA Appendix A-2, Section 18.2.12.3, the applicant provided proposed FSAR supplements for McGuire and Catawba, respectively. The staff reviewed this information and found it to be in agreement with the information in Section 3.17.3.2 of LRA Appendix B and is, therefore, acceptable.

During its review of the information in Section 2.3.3.12; Tables 3.3-15 and 3.3-16, pages 3.3-121 through 3.3-130; and Section B.3.17.3.2 of the LRA, the staff identified the need for additional information pertaining to this AMP. By letter dated January 23, 2002, the staff requested, in RAI 3.3.15-1, additional information pertaining to Table 3.3-15, "Aging Management Review Results for Diesel Generator Cooling Water System (McGuire Nuclear Station)." This table indicates that the aging effect of loss of material in a raw water environment to the diesel generator cooling water heat exchangers is managed by the Galvanic Susceptibility Inspection program. The scope of this program, as defined in Appendix B, Section B.3.16, of the LRA does not include the diesel generator cooling water heat exchangers. The staff requested confirmation that the Galvanic Susceptibility Inspection program manages the aging effects to the diesel generator cooling water heat exchangers.

In its response dated March 15, 2002, the applicant stated that the diesel generator cooling water heat exchangers reject heat from the diesel generator cooling water system to the nuclear service water system. The channel heads and tubesheets are constructed of carbon steel that is electrolytically coupled to stainless steel and copper, respectively, in the presence of raw water supplied by the nuclear service water system. The scope of the Galvanic Susceptibility Inspection, as described in Appendix B of the LRA, includes the galvanic couples of the nuclear service water system, which would include the galvanic couples in the portion of the diesel generator cooling water heat exchangers exposed to raw water in the nuclear service water system. Since the scope of the Galvanic Susceptibility Inspection includes the galvanic couples in a portion of the diesel generator cooling water heat exchangers, the aging effect will be managed by the program. The staff finds that the applicant's response clarifies and satisfactorily resolves this item.

The staff has reviewed the information in Section B.3.17.3.2, Appendix B of the LRA. On the basis of this review and the above evaluation, and with the resolution of open item

3.0.3.9.1.2(f), the staff finds that there is reasonable assurance that the applicant has demonstrated that the effects of aging associated with the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Cooling Water program 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).

Based on its review of Tables 3.3-15 and 3.3-16 and Appendix B of the LRA, the staff concludes that the above identified AMPs will effectively manage the aging effects of the diesel generator cooling water system, and that there is reasonable assurance that the intended functions of the diesel generator air intake and exhaust system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.12.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.12 and Tables 3.3-15 and 3.3-16. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the diesel generator cooling water system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.13 Diesel Generator Crankcase Vacuum System

3.3.13.1 Technical Information in the Application

The diesel generator crankcase vacuum system is essentially the same, and performs the same function, for McGuire and Catawba. The diesel generator crankcase vacuum system purges the diesel engine crankcase to reduce the concentration of combustible gasses. McGuire UFSAR Section 9.5.9, "Diesel Generator Crankcase Vacuum System," provides additional information concerning the McGuire diesel generator crankcase vacuum system.

3.3.13.1.1 Aging Effects

Components of the diesel generator crankcase vacuum system are described in Section 2.3.3.13 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-17, pages 3.3-131 through 3.3-133, lists individual components of the system, including the blowers, oil separators, orifices, piping, tubing, and valve bodies. Stainless steel components exposed to sheltered and ventilation environments demonstrate no aging effects. Internal surfaces of carbon steel components exposed to ventilation environment have no aging effects. External surfaces of carbon steel exposed to yard and sheltered environments demonstrate the aging effect of loss of material. Brass and copper exposed to ventilation and sheltered environments show no aging effects.

3.3.13.1.2 Aging Management Programs

The Inspection Program for Civil Engineering Structures and Components is utilized to manage aging effects for the diesel generator crankcase vacuum system. A description of the aging management program is provided in LRA Appendix B. The applicant concludes that the effects of aging associated with the components of the diesel generator crankcase vacuum system will be adequately managed by the aging management program during the period of extended operation.

3.3.13.2 Staff Evaluation

The applicant described its AMR of the diesel generator crankcase vacuum system for license renewal in two separate sections of its LRA, Section 2.3.3.13 and Table 3.3-17, pages 3.3-131 through 3.3-133. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the diesel generator crankcase vacuum system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.13.2.1 Aging Effects

The aging effects that result from contact of the diesel generator crankcase vacuum SSCs to the environments described in LRA Section 2.3.3.13 and Table 3.3-17, pages 3.3-131 through 3.3-133, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.13.2.2 Aging Management Programs

LRA Section 2.3.3.13 and Table 3.3-17, pages 3.3-131 through 3.3-133, state that the Inspection Program for Civil Engineering Structures and Components is credited for managing the aging effects in the diesel generator crankcase vacuum system. The Inspection Program for Civil Engineering Structures and Components is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common aging management program. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-17, the staff concludes that the above identified AMP will effectively manage the aging effects of the diesel generator crankcase vacuum system, and that there is reasonable assurance that the intended functions of the diesel generator crankcase vacuum system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.13.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.13 and Table 3.3-17, pages 3.3-131 through 3.3-133. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the diesel generator crankcase vacuum system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.14 Diesel Generator Fuel Oil System

3.3.14.1 Technical Information in the Application

The McGuire diesel generator fuel oil system is relied upon to maintain two trains of fuel oil storage and supply for the emergency diesel generators for a period of operation of no less than 5 days. McGuire UFSAR Section 9.5.4, "Diesel Generator Fuel Oil System," provides additional information concerning the McGuire diesel generator fuel oil system.

The Catawba diesel generator engine fuel oil system is relied upon to maintain two trains of fuel oil storage and supply for the emergency diesel generators for a period of operation of no less than 7 days. Catawba UFSAR Section 9.5.4, "Diesel Generator Engine Fuel Oil System," provides additional information concerning the Catawba diesel generator engine fuel oil system.

3.3.14.1.1 Aging Effects

Components of the diesel generator fuel oil system are described in Section 2.3.3.14 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Tables 3.3-18 and 3.3-19, pages 3.3-134 through 3.3-141, list individual components of the system, including pump casing, tanks, filters, flame arrestors, flow meters, orifices, strainers, pipes, tubing, and valve bodies. Stainless steel components exposed to an internal environment of oil are subject to the aging effect of loss of material. Exposure of external surfaces of stainless steel to an underground environment causes the aging effects of cracking and loss of material. Exposure of stainless steel to ventilation, yard, and sheltered environments has no aging effect. Exposure of carbon steel to internal and external environments of oil, underground, and sheltered environments is subject to the aging effect of loss of material. Exposure of internal surfaces of carbon steel components exposed to a ventilation environment has no aging effect. Cast iron components exposed to oil (internal) and sheltered (external) environments are subject to the aging effect of loss of material.

3.3.14.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the diesel generator fuel oil system:

- Inspection Program for Civil Engineering Structures and Components
- Chemistry Control Program
- Preventive Maintenance Activities — Condenser Circulating Water System Internal Coating Inspection

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the diesel generator fuel oil system will be adequately managed by these aging management programs during the period of extended operation.

3.3.14.2 Staff Evaluation

The applicant described its AMR of the diesel generator fuel oil system for license renewal in two separate sections of its LRA, Section 2.3.3.14 and Tables 3.3-18 and 3.3-19, pages 3.3-134 through 3.3-141. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the diesel generator fuel oil system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.14.2.1 Aging Effects

The aging effects that result from contact of the diesel generator fuel oil SSCs to the environments described in LRA Section 2.3.3.14 and Tables 3.3-18 and 3.3-19, pages 3.3-134 through 3.3-141, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.14.2.2 Aging Management Programs

LRA Section 2.3.3.14 and Tables 3.3-18 and 3.3-19, pages 3.3-134 through 3.3-141, state that the following aging management programs are credited for managing the aging effects in the diesel generator fuel oil system.

- Inspection Program for Civil Engineering Structures and Components
- Chemistry Control Program
- Preventive Maintenance Activities — Condenser Circulating Water System Internal Coating Inspection

The Chemistry Control Program, Inspection Program for Civil Engineering Structures and Components, and Preventive Maintenance Activities — Condenser Circulating Water System Internal Coating Inspection program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Tables 3.3-18 and 3.3-19, the staff concludes that the above identified AMPs will effectively manage the aging effects of the diesel generator fuel oil system, and that there is reasonable assurance that the intended functions of the diesel generator fuel oil system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.14.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.14 and Tables 3.3-18 and 3.3-19, pages 3.3-134 through 3.3-141. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the diesel generator fuel oil system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.15 Diesel Generator Lube Oil System

3.3.15.1 Technical Information in the Application

The McGuire and Catawba diesel generator lube oil systems are essentially the same and perform the same function. The diesel generator lube oil system supplies lubricating oil to the diesel engine and its bearings, crankshaft, thrust faces, and other friction surfaces during both the standby mode and operation mode of the diesel generator. McGuire UFSAR Section 9.5.7, "Diesel Generator Lubricating Oil System," provides additional information concerning the McGuire diesel generator lube oil system. Catawba UFSAR Section 9.5.7, "Diesel Generator Engine Lube Oil System," provides additional information concerning the Catawba diesel generator engine lube oil system.

3.3.15.1.1 Aging Effects

Components of the diesel generator lube oil system are described in Section 2.3.3.15 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Tables 3.3-20 and 3.3-21, pages 3.3-142 through 3.3-148, list individual components of the system, including pump casing, oil coolers, tanks, flexible hoses, strainers, oil filters, oil heaters, pipes, tubing, and valve bodies. Stainless steel components exposed to internal or external oil and sheltered environments are not subject to any aging effects. Carbon steel components exposed to an internal environment of treated water are subject to the aging effects of cracking and loss of material. Internal surfaces of carbon steel exposed to oil have no aging effect. Exposure of carbon steel to a sheltered or yard external environment causes loss of material. Cast iron components exposed to an internal environment of oil are not subject to any aging effects, while external surfaces exposed to sheltered environments are subject to loss of material. Copper alloy, copper-nickel, and brass components exposed to a treated water internal environment are subject to cracking and loss of material. Exposure of copper alloy and brass to an external environment of oil has no aging effect.

3.3.15.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the diesel generator lube oil system:

- Inspection Program for Civil Engineering Structures and Components
- Chemistry Control Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the diesel generator lube oil system will be adequately managed by these aging management programs during the period of extended operation.

3.3.15.2 Staff Evaluation

The applicant described its AMR of the diesel generator lube oil system for license renewal in two separate sections of its LRA, Section 2.3.3.15 and Tables 3.3-20 and 3.3-21, pages 3.3-142 through 3.3-148. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the diesel generator lube oil system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.15.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.15 and Tables 3.3-20 and 3.3-21, pages 3.3-142 through 3.3-148. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3-3, additional information pertaining to LRA Tables 3.3-16, 3.3-20, and 3.3-21. Table 3.3-16 (pages 3.3-126 to 3.3-130) indicates that the Catawba diesel generator governor lube oil coolers (tubes) are subject to an internal/external environment of treated water/oil. According to Tables 3.3-16, 3.3-20, and 3.3-21 of the LRA, the diesel generator engine lube oil coolers (tubes, tubesheets and/or shells) are listed as subject to an internal/external environment of treated water/oil. The staff requested that the applicant identify where in the LRA the aging effect of loss of material was addressed.

In its response dated March 15, 2002, the applicant stated that all of the lube oil cooler components cited in the first paragraph of RAI 3.3-3 are components of closed oil recirculation systems. Uncontaminated lube oil does not cause aging, and closed oil recirculation systems are assumed to be initially free of contaminants, such as water. Further, in the Duke aging management review, component failures were not postulated as a means to establish the relevant conditions required for aging to occur. Therefore, in oil coolers, tube failures that could introduce water into a lube oil environment are not assumed. The staff agrees that uncontaminated oil will not cause any aging effect to the components, and that the applicant is not required to assume a failure that can cause an aging effect. The staff finds that the applicant's response to RAI 3.3-3 clarifies and satisfactorily resolves this item.

In its April 15, 2002, response to RAI 2.3.3.15-4, the applicant stated that the diesel generator lube oil heater pump casings were within the scope of license renewal (see Section 2.3.3.15.2 of this SER). The following AMR results for these components were provided in the applicant's response:

Component Type	Component Function	Material	Internal Environment / External Environment	Aging Effects	Aging Management Programs and Activity
D/G Lube Oil Heater Pump Casings	PB	CS	Oil	None Identified	None Required
			Sheltered	Loss of Material	Inspection Program for Civil Engineering Structures and Components

The aging effects that result from contact of the diesel generator lube oil SSCs to the environments described in the applicant's response to RAI 2.3.3.15-4, LRA Section 2.3.3.15, and Tables 3.3-20 and 3.3-21, pages 3.3-142 through 3.3-148, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.15.2.2 Aging Management Programs

LRA Section 2.3.3.15 and Tables 3.3-20 and 3.3-21, pages 3.3-142 through 3.3-148, state that the following aging management programs are credited for managing the aging effects in the diesel generator lube oil system.

- Inspection Program for Civil Engineering Structures and Components
- Chemistry Control Program

The Chemistry Control Program and Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

The staff reviewed the information in LRA Section 2.3.3.15 and Tables 3.3-20 and 3.3-21, pages 3.3-142 through 3.3-148. During its review, the staff determined that additional information was needed to complete its review.

By letter dated January 23, 2002, the staff requested, in RAI 3.3-3, additional information on Tables 3.3-20 and 3.3-21, "Aging Management Review Results for Diesel Generator Lube Oil System (McGuire Nuclear Station)." These tables indicate that the aging effect of cracking and loss of material in a lube oil environment is managed by the Chemistry Control Program. The scope of this program, as defined in LRA Appendix B, Section B.3.6, only refers to fuel oil environments and not lube oil. The staff asked if the Chemistry Control Program manages the aging effects in a lube oil environment.

In its response dated March 15, 2002, the applicant stated that all of the lube oil cooler components cited in the first paragraph of RAI 3.3-3 are components of closed oil recirculation systems. Uncontaminated lube oil does not cause aging, and closed oil recirculation systems are assumed to be initially free of contaminants, such as water. Further, in the Duke aging management review, component failures were not postulated as a means to establish the relevant conditions required for aging to occur. Therefore, in oil coolers, tube failures that could introduce water into a lube oil environment are not assumed. The staff agrees that uncontaminated oil will not cause any aging effect to the components, and that the applicant is not required to assume a failure that can cause an aging effect. The staff finds that the applicant's response to RAI 3.3-3 clarifies and satisfactorily resolves this item.

Based on its review of LRA Tables 3.3-20 and 3.3-21, the staff concludes that the above identified AMPs will effectively manage the aging effects of the diesel generator lube oil system, and that there is reasonable assurance that the intended functions of the diesel generator lube oil system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.15.3 Conclusions

The staff reviewed the information in the applicant's response to RAI 2.3.3.15-4; Sections 2.3.3.15 and B.3.6 of the LRA; and Tables 3.3-18, 3.3-19, 3.3-20 and 3.3-21 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the diesel generator lube oil system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.16 Diesel Generator Room Sump Pump System

3.3.16.1 Technical Information in the Application

The McGuire diesel generator room sump pump system removes leakage from equipment drains in the diesel building, and protects the diesel generators from flooding due to a nuclear service water system pipe rupture in one of the diesel rooms acting simultaneously with a turbine building flood. McGuire UFSAR Section 9.5.10, "Diesel Generator Room Sump Pump System," provides additional information concerning the McGuire diesel generator room sump pump system.

The Catawba diesel generator room sump pump system removes normal leakage and drainage from various equipment in the diesel generator rooms. Catawba UFSAR Section 9.5.9, "Diesel Generator Room Sump Pump System," provides additional information concerning the Catawba diesel generator room sump pump system.

3.3.16.1.1 Aging Effects

Components of the diesel generator room sump pump system are described in Section 2.3.3.16 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-22, pages 3.3-149 through 3.3-150, lists individual components of the system, including pump casings, orifices, pipes, and valve bodies. Stainless steel and carbon steel components exposed to an internal raw water environment experience loss of material. Exposure of stainless steel to sheltered environments is not subject to any aging effects, while exposure of carbon steel to a sheltered or yard external environment demonstrates loss of material. Cast iron components (McGuire) are subject to the aging effect of loss of material when exposed to an internal environment of raw water and a sheltered external environment.

3.3.16.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the diesel generator room sump pump system:

- Inspection Program for Civil Engineering Structures and Components
- Selective Leaching Inspection (McGuire only)
- Galvanic Susceptibility Inspection
- Sump Pump System Inspection

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the diesel generator room sump pump system will be adequately managed by these aging management programs during the period of extended operation.

3.3.16.2 Staff Evaluation

The applicant described its AMR of the diesel generator room sump pump system for license renewal in two separate sections of its LRA, Section 2.3.3.16 and Table 3.3-22, pages 3.3-149 through 3.3-150. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the diesel generator room sump pump system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.16.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.16 and Table 3.3-22, pages 3.3-149 through 3.3-150. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3.22-1, additional information pertaining to Table 3.3-22, "Aging Management Review Results for the Diesel Generator Room Sump Pump System." This table indicates that orifices provide the function "PB." Typically, orifices also provide the function listed in Note (1) as "TH." The applicant was asked to explain why orifices in the diesel generator room sump pump system do not provide the function "TH," or to correct the component functions for orifices listed in Table 3.3-22.

In its response dated March 15, 2002, the applicant stated that the system intended function of the diesel generator room sump pump system is to remove the contents of the diesel generator room sump to prevent room flooding that could damage equipment. The orifice included in Table 3.3-22 is located in a normally isolated recirculation line that is only used for testing the diesel generator room sump pumps. Throttling is, therefore, not an intended function of the orifice for license renewal. Since the orifice is only used for test run and not intended as "TH" function for normal operation, the staff finds the applicant's response acceptable.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.22-2, additional information pertaining to Table 3.3-22, "Aging Management Review Results for the Diesel Generator Room Sump Pump System." This table has a Note (3), which implies that portions of the diesel generator room sump pump system may be subject to alternate wetting and drying; however, this note is not used in the table. The applicant was requested to clarify if Note (3) is applicable to Table 3.3-22. If so, the applicant should explain how the aging effects associated with this environment will managed during the period of extended operation.

In its response dated March 15, 2002, the applicant stated that Note (3), which implies some portions of the diesel generator room sump pump system are exposed to an alternate wetting and drying environment, is not applicable to Table 3.3-22 of the LRA. No components in the diesel generator room sump pump system within the scope of license renewal are exposed to an alternate wetting and drying environment, which may concentrate contaminants. The staff finds that the applicant's response clarifies and satisfactorily resolves this item, since the components are not subject to an alternate wetting and drying environment, and the aging effect is not applicable.

The aging effects that result from contact of the diesel generator room sump pump SSCs to the environments described in LRA Section 2.3.3.16 and Table 3.3-22, pages 3.3-149 through 3.3-150, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.16.2.2 Aging Management Programs

LRA Section 2.3.3.16 and Table 3.3-22, pages 3.3-149 through 3.3-150, state that the following aging management programs are credited for managing the aging effects in the diesel generator room sump pump system.

- Inspection Program for Civil Engineering Structures and Components
- Selective Leaching Inspection (McGuire only)
- Galvanic Susceptibility Inspection
- Sump Pump System Inspection

The Galvanic Susceptibility Inspection program, Inspection Program for Civil Engineering Structures and Components, Selective Leaching Inspection (McGuire only) program, and Sump Pump System Inspection program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-22, the staff concludes that the above identified AMPs will effectively manage the aging effects of the diesel generator sump pump system, and that there is reasonable assurance that the intended functions of the diesel generator sump pump system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.16.3 Conclusions

The staff reviewed the information in Section 2.3.3.16 and Table 3.3-22 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the diesel generator room sump pump system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.17 Diesel Generator Starting Air System

3.3.17.1 Technical Information in the Application

The McGuire and Catawba diesel generator starting air systems are essentially the same and perform the same function. The diesel generator starting air system provides fast start capability for the emergency diesel engine by using compressed air to roll the engine until it starts. The diesel generator starting air system also supplies air to the diesel controls to operate and shutdown the engine. McGuire UFSAR Section 9.5.6, "Diesel Generator Starting Air System," provides additional information concerning the McGuire diesel generator starting air system. Catawba UFSAR Section 9.5.6, "Diesel Generator Engine Starting Air System," provides additional information concerning the Catawba diesel generator engine starting air system.

3.3.17.1.1 Aging Effects

Components of the diesel generator starting air system are described in Section 2.3.3.17 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Tables 3.3-23 and 3.3-24, pages 3.3-151 through 3.3-157, list individual components of the system, including air filters, tanks, coolers, flow meters, moisture separators, orifices, silencers, y-strainers, expansion joints, pipes, tubing, and valve bodies. Exposure of stainless steel to a sheltered external environment has no aging effect. Exposure of external surfaces of carbon steel to sheltered environments demonstrates loss of material. Stainless steel and carbon steel exposed to an internal environment of dry air has no aging effect. Exposure of stainless steel and carbon steel to a raw water environment demonstrates loss of material. Exposure of stainless steel and carbon steel to moist air environments has no aging effect. Monel 400 components exposed to an internal environment of raw water are subject to loss of material, while the same components exposed to an external environment of moist air have no aging effects.

3.3.17.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the diesel generator starting air system:

- Inspection Program for Civil Engineering Structures and Components
- Service Water Piping Corrosion Program (Catawba only)
- Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air (Catawba only)

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the diesel generator starting air system will be adequately managed by these aging management programs during the period of extended operation.

3.3.17.2 Staff Evaluation

The applicant described its AMR of the diesel generator starting air system for license renewal in two separate sections of its LRA, Section 2.3.3.17 and Tables 3.3-23 and 3.3-24, pages 3.3-151 through 3.3-157. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the diesel generator starting air system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.17.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.17 and Tables 3.3-23 and 3.3-24, pages 3.3-151 through 3.3-157. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3.24-1, additional information pertaining to Table 3.3-24, "Aging Management Review Results — Diesel Generator Starting Air System (Catawba Nuclear Station)." This table identifies only a PB function for the diesel generator engine starting air aftercooler tubes. The applicant was requested to explain why the heat transfer (HT) function, which ensures the system and/or component operating temperatures are maintained, is not considered in the AMR, or to correct the component functions for diesel generator engine starting air aftercooler tubes listed in Table 3.3-24 of the LRA.

In its response dated March 15, 2002, the applicant stated that the diesel generator starting air aftercooler is not required to transfer heat for the safety-related diesel to perform its function. The diesel generator starting air aftercooler, and associated piping and components, are non-safety-related because they are not required to function for the diesel to start and operate. The aftercooler is within the scope of license renewal because both sides of the cooler have a pressure boundary function. The pressure boundary of the cooling water side of the aftercooler is safety-related because it forms a pressure boundary of the safety-related nuclear service water system and is, therefore, within scope. The pressure boundary of the air side of the aftercooler is non-safety-related, but is seismically designed and designated Class F. Therefore, the pressure boundary of the air side of the aftercooler meets the criteria of 10 CFR 54.4(a)(2) and is within scope. The Class F design was applied to the system to minimize the effort to regain the diesel in a post seismic situation. Since the aftercooler is not required to transfer heat during the startup of the diesel generator, the staff agrees that HT function is not a required function.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.24-2, additional information pertaining to Table 3.3-24, of the LRA, "Aging Management Review Results — Diesel Generator Starting Air System (Catawba Nuclear Station)." This table indicates that the Diesel generator engine starting air aftercooler tubes are made of stainless steel, and are subject to loss of material from exposure to a raw water internal environment. Typically, the aging effect, fouling, is also associated with raw water environments. The applicant was requested to identify where in the LRA the AMR results are for the aging effect of fouling to these components, or to provide a justification for excluding this aging effect from Table 3.3-24 of the LRA and an AMR.

In its response dated March 15, 2002, the applicant stated that fouling can cause a loss of heat transfer function, but does not affect the pressure boundary function of the diesel generator starting air system aftercooler tubes. As discussed in the response to RAI 3.3.24-1 above, heat transfer is not a component intended function of the aftercooler tubes. The staff agrees with the applicant that fouling is not an applicable aging effect since heat transfer is not an intended function that meets the scoping criteria of 10 CFR 54.4.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.24-4, additional information pertaining to Table 3.3-24, of the LRA, "Aging Management Review Results — Diesel Generator Starting Air System (Catawba Nuclear Station)." This table identifies several components where carbon steel is exposed to an air (moist) environment with no aging effects or aging management program required. Loss of material from general, pitting, and crevice corrosion is an applicable aging effect for carbon steel materials in air environments containing moisture. General corrosion results from chemical or electrochemical reaction between the material and the air environment when both oxygen and moisture are present. The applicant was requested to identify where in the LRA the AMR results are for these aging effects, or to provide a justification for excluding these aging effects from LRA Table 3.3-24.

In its response dated March 15, 2002, the applicant stated that LRA Table 3.3-24 presents the results of the aging management review for the diesel generator starting air system. Loss of material due to crevice, general, galvanic, and pitting corrosion was evaluated for the diesel generator starting air system carbon steel components exposed to moist air. Duke determined that crevice, galvanic, and pitting corrosion were not a concern for the period of extended operation. Crevice and pitting corrosion are a concern in air environments where surfaces are alternately wetted and dried, which could concentrate contaminants. Galvanic corrosion occurs in an air environment when dissimilar materials are wet. These conditions do not exist in the moist air portion of the diesel generator starting air system.

Duke considered loss of material due to general corrosion of the carbon steel components, and determined that it was not an aging effect requiring management during the period of extended operation. Absent other influences, such as wetting and drying, general corrosion of carbon steel occurs at a slow rate. The entire diesel generator starting air system is located in the same room with the diesel engines and is normally in standby. The system draws air from the diesel room to charge the tanks. The diesels are warmed to 125 °F and that results in a room temperature of around 100 °F. The air environment inside the system, before the dryers, can be characterized as stagnant warm air of a low humidity. This environment would not promote aggressive general corrosion that could result in a loss of the component intended function if left unmanaged for the period of extended operation. Therefore, loss of material due to general corrosion of the carbon steel components exposed to moist air is not an aging effect requiring management during the period of extended operation. Since the applicant stated that the air environment inside the system, before the dryers, can be characterized as stagnant warm air of a low humidity, the staff agrees that localized and general corrosion are very unlikely to occur.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.24-5, additional information pertaining to LRA Table 3.3-24, "Aging Management Review Results — Diesel Generator Starting Air System (Catawba Nuclear Station)." This table identifies air (dry) and air (moist) as potential environments for the diesel generator starting air system. Descriptions for these environments are not provided in LRA Section 3.3.1, "Aging Management Review Results Tables." The applicant was requested to identify where in the LRA these environments are defined, or to provide additional information in LRA Section 3.3.1.

In its response dated March 15, 2002, the applicant stated that the two environments, air (moist) and air (dry), were provided in LRA Table 3.3-24 to show that the air environment was not the same throughout the diesel generator starting air system. Both of these air environment variations are bounded by the "Air-Gas" environment definition in Section 3.3.1 of the LRA. The diesel generator starting air system takes air from the diesel room. The air is filtered, compressed, dried, and stored in tanks to be used to start the diesels. The air (moist) environment is the environment prior to the air dryers. The air (dry) environment is the environment after the air dryers.

In electronic correspondence dated May 2, 2002 (ADAMS Accession No. ML021440217), the staff indicated that the applicant's response addressed the original question dealing with defining the air (moist) and air (dry) environmental conditions. However, the initial RAI attempted to determine why no aging effects were identified for carbon steel in the air (moist) environment. Aging mechanisms and rates can vary depending on the moisture content in these environments. The staff requested that the applicant provide additional detail to address aging effects under the air (moist) environment.

In electronic correspondence dated May 10, 2002 (ADAMS Accession No. ML021440236), the applicant replied that Duke believes that characterizing the environment as moist air is misleading. The applicant noted its initial response, in which it stated that the diesel generator starting air system takes air from the diesel room. Since the diesels are heated, the moist air of the diesel rooms is in excess of 100 °F and has a low relative humidity. The diesel generator starting air system filters, compresses, and further dries this air for storage in the system tanks for later use. The diesel room air does not preclude loss of material, but does not promote the aggressive corrosion that, left unmanaged, could result in a loss of the intended function(s) of the components. Therefore, no aging effects requiring management during the period of extended operation were identified.

By letter dated July 9, 2002, the staff received this explanation in official correspondence. The applicant confirmed that the diesel starting air system components are exposed to an environment with low relative humidity, and that the diesel generator starting air system filters, compresses, and further dries this air for storage in the system tanks for later use. The staff finds that, since the diesel room air does not promote the aggressive corrosion that could result in a loss of the intended function(s) of the system components, this issue is resolved.

In its April 15, 2002, response to RAI 2.3.3.17-2, the applicant determined that the diesel generator starting air distributor filter was within the scope of license renewal (see Section 2.3.3.17.2 of this SER). The following AMR results for this component were provided in the applicant's response:

Component Type	Component Function	Material	Internal Environment / External Environment	Aging Effect	Aging Management Programs and Activities
Starting Air Distributor Filter	PB	CS	Air (Dry) / Sheltered	None Identified / None Identified	None Required / None Required

The staff finds that the applicant's AMR results are not consistent with the other carbon steel components in a sheltered environment, which the applicant indicated (in the LRA) are subject to the aging effect of loss of material. Since the applicant has not identified this aging effect for the diesel generator starting air distributor filter, and credited an AMP to manage this aging effect, the staff finds that the aging effect (none) listed is not appropriate for the combination of material and environment identified. Therefore, this issue was characterized as SER open item 3.3.17.2.1-1.

In its response dated October 28, 2002, the applicant provided the following revised AMR results table for the diesel generator starting air distributor filter:

Component Type	Component Function	Material	Internal Environment / External Environment	Aging Effect	Aging Management Programs and Activities
Starting Air Distributor Filter	PB	CS	Air (Dry) / Sheltered	None Identified / Loss of Material	None Required / Inspection Program for Civil Engineering Structures and Components

The applicant's response to SER open item 3.3.17.2.1-1 specifies loss of material as an aging effect for the carbon steel starting air distributor filter, and credits the Inspection Program for Civil Engineering Structures and Components. The aging effect specified is consistent with industry experience for the combination of materials and environments identified. Therefore, this response is acceptable to the staff and resolves open item 3.3.17.2.1-1.

The staff finds that the applicant's responses to SER open item 3.3.17.2.1-1, and to RAIs 3.3.24-1, 3.3.24-2, 3.3.24-4, and 3.3.24-5, clarify and satisfactorily resolve these items. The aging effects that result from contact of the diesel generator starting air SSCs to the environments described in LRA Section 2.3.3.17 and LRA Tables 3.3-23 and 3.3-24, pages 3.3-151 through 3.3-157, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, and with the resolution of open item 3.3.17.2.1-1, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.17.2.2 Aging Management Programs

LRA Section 2.3.3.17 and Tables 3.3-23 and 3.3-24, pages 3.3-151 through 3.3-157, and subsequent correspondence from the applicant, state that the following aging management programs are credited for managing the aging effects in the diesel generator starting air system.

- Inspection Program for Civil Engineering Structures and Components
- Service Water Piping Corrosion Program (Catawba only)
- Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air (Catawba only)

The Inspection Program for Civil Engineering Structures and Components and Service Water Piping Corrosion Program (Catawba only) are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. The staff's evaluation of the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air (Catawba only) program follows.

Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air Program (Catawba only)

The applicant described its Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air in Section B.3.17.5 of LRA Appendix B. The staff reviewed the LRA to determine whether the applicant had demonstrated that this program will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3). This program is applicable only to Catawba. Because of the different materials and environments of the McGuire diesel generator starting air system components, the aging effects are not the same as those that are found at Catawba. The only aging effect at McGuire is loss of material for subject piping and tanks, which is managed by the Inspection Program for Civil Engineering Structures and Components.

Section B.3.17.5 of LRA Appendix B provides a description of the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air. The stated purpose of the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air is to manage loss of material for parts of the diesel generator engine starting air aftercoolers that are exposed to raw water. The applicant described the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air as a condition monitoring program that monitors specific component parameters to detect the presence, and assess the extent, of material loss that can affect the pressure boundary function. The applicant credits the program with managing loss of material for carbon steel and stainless steel materials.

The staff's evaluation of the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air program focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The applicant indicated that the corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] As described in the LRA, the scope of the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air includes the tubes and channel heads of the diesel generator engine starting air aftercooler. The staff finds the scope of this activity to be acceptable because it includes those components important to assuring that the pressure boundary is maintained.

[Preventive or Mitigative Actions] The applicant stated that no actions are taken as part of this program to prevent aging effects or to mitigate aging degradation. The staff agrees with the applicant because the purpose of the program is to detect and assess the extent of material loss, not to prevent such loss.

[Parameters Monitored or Inspected] In conducting the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air program, the applicant inspects the aftercooler tube and channel head surfaces for loss of material. The staff finds this approach to be acceptable because it will allow the applicant to identify material loss and take corrective action prior to loss of component function.

[Detection of Aging Effects] The applicant stated that based on information provided under the Monitoring and Trending section, the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air program will detect loss of material due to crevice, galvanic, general, pitting, microbiologically influenced corrosion, and loss of material due to particle erosion prior to loss of the component intended function. The staff's review found this acceptable, because the applicant performs visual inspections of the channel head surface using a boroscope (for tubes), which is a standard industry method. The staff agrees that the program is capable of detecting and correcting aging degradation before loss of component function.

[Monitoring and Trending] As described in the application, the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air manages loss of material of the tubes and channel heads by means of two visual inspections. Loss of material of the tube internal surfaces is managed by an annual inspection. This inspection uses a boroscope to visually inspect the tubes.

The applicant stated that loss of material of the channel heads is managed by an annual visual inspection of the protective coatings to assure the integrity of the underlying base metal. The channel heads of the diesel generator engine starting air aftercoolers are coated with a high solids epoxy. The coating inspection specifically identifies rust blooms, which indicate a coating defect and corrosion of the base metal.

The applicant takes no actions as part of this activity to trend inspection results. The staff did not identify the need for trending actions. The staff finds that the annual inspections are capable of identifying loss of material or other aging effects prior to loss of component function.

[Acceptance Criteria] The applicant stated that the acceptance criteria for the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air is no unacceptable loss of material of the tubes and channel heads that could result in a loss of the component intended function(s), as determined by engineering evaluation. The staff did not consider this an adequate acceptance criterion for the heat exchanger preventive maintenance activities AMP. The staff requested the applicant to specify parameters with quantitative limits, and this issue was characterized as SER open item 3.0.3.9.1.2(g).

In its response to SER open item 3.0.3.9.1.2(b-g), dated October 28, 2002, the applicant indicated that eddy current testing is the method used to manage loss of material of the subject heat exchanger tubes. Eddy current testing is a standard industry practice used for detecting wall loss in heat exchangers, but requires careful engineering evaluation of all test results to provide the proper management of a heat exchanger. Steam generators are the only plant heat exchangers for which station technical specifications or sets of standards exist to define the flaw depth at which a tube must be plugged and removed from service.

For the low pressure, low temperature heat exchangers to which SER open items 3.0.3.9.1.2 (b-g) apply, evaluating eddy current test results for "unacceptable loss of material" involves many variables, such as tube material, characterization of the indication in terms of percent wall loss, rate of degradation as compared to previous indications, and the frequency of subsequent testing. Criteria such as ASME Code requirements, additional inspection results, and operating experience may be used to assess the severity of the degradation and the need for corrective actions.

The applicant further explained that eddy current testing at McGuire and Catawba is performed by a vendor who specializes in the practice. A 4-step process is used to determine if test results are acceptable and to generate the final test report. This process is described in detail in the applicant's October 28, 2002, response to this SER open item. The following is the process described by the applicant:

> (1) At the conclusion of testing of a component, the vendor's eddy current testing manager reviews the data and makes a plugging recommendation in the preliminary report based on his assessment of the damage flaws and experience with testing the component. Experience demonstrates that these specialists generally recommend evaluation at around a 70 percent wall loss range.
>
> (2) Duke then reviews the entire test data provided in the preliminary test report, including the recommendation for plugging, prior to returning the component to service. Duke evaluates the recommendations using all the information they have available. Particularly, Duke evaluates the rate of degradation based on the history of the tube. The wall loss may be deemed acceptable if the tube is showing minimal to no degradation from previous inspections. Consideration is also given to the frequency of the next inspection; if frequent inspection is performed, then a higher wall loss range may be acceptable and if less frequent inspection is performed then lower wall loss range may be unacceptable.
>
> (3) Depending on the type of tubing material and tubing damage detected with eddy current testing and possibly verified with actual tube pulled samples, a wall loss correlation may be determined as a threshold for evaluating the tube for plugging repair. Past operating experience with the type of tubing flaw may also be a very useful factor in determining the wall loss plugging threshold.
>
> (4) The loss of material experienced by these heat exchanger tubes generally manifests itself as pits. These pitting flaws are not very likely to fail heat exchanger tubing due to mechanical stress of pressure and temperature due to the shouldered nature or material reinforcement around pits. Therefore, the pitting rate as determined from past eddy current testing experience becomes the primary factor to consider when selecting tubes to remove from service to prevent later on-line tube leaks.

The applicant further stated that its experience in evaluating eddy current testing results has proven to be effective during the operation of McGuire and Catawba. Corrective actions, such as tube plugging and tube bundle and heat exchanger replacement, have been taken as a result of failed acceptance criteria of the subject programs. On the basis of the information provided in the applicant's October 28, 2002, open item response, the staff finds that appropriate and adequate acceptance criteria for detecting heat exchanger tube degradation from loss of material are identified for these aging management programs. Therefore, open items 3.0.3.9.1.2(b-g) are closed.

[Operating Experience] The applicant stated that its operating experience associated with the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air program has demonstrated that visual inspection of the aftercooler tubes and channel heads provides adequate information, in regards to wall loss present in the aftercooler components, to predict when corrective action is required. Corrective action in the form of tube plugging or coating repair, for example, is performed before the loss of the component intended function. Results of the inspection have led the applicant to replace the aftercooler tubes and the coating of the tubesheets and channel heads. The applicant stated that original equipment Monel tubes in the diesel generator engine starting air aftercoolers were retubed with stainless steel in 1996 and 1997. Monel tubes had shown signs of serious pitting damage. According to the applicant, the replacement stainless steel tubes are also showing signs of pitting as well, but to a lesser degree than the Monel, and are being evaluated for retubing.

The applicant's operating experience has demonstrated that the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air program is an effective program for managing the effects of aging. The program, with its proven monitoring techniques, acceptance criteria, corrective actions, and administrative controls, accurately predicts aging effects due to corrosion and erosion.

FSAR Supplement: In LRA Appendix A-2, Section 18.2.12.5, the applicant has provided proposed FSAR supplement for Catawba. This program will be applied only at Catawba. The staff reviewed this information and found it to be consistent with the information provided in LRA Appendix B, Section B.3.17.17.5, and, therefore, acceptable.

During its review of information in LRA Section 2.3.3.17; Tables 3.3-23 and 3.3-24, pages 3.3-151 through 3.3-157; and LRA Section B.3.17.5, the staff identified the need for additional information pertaining to this AMP. By letter dated January 23, 2002, the staff requested, in RAI 3.3.24-3, additional information pertaining to Table 3.3-24, "Aging Management Review Results — Diesel Generator Starting Air System (Catawba Nuclear Station)." This table identifies the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air as the aging management program to manage the aging effect of loss of material in a raw water environment for the diesel generator engine starting air aftercooler tubes and channel head, but not the tubesheet, which is Monel 400 material. Section 18.2.12.5 of the FSAR supplement, "Diesel Generating Starting Air," credits this program for managing aging of carbon steel, stainless steel, and Monel materials. The applicant was asked if the Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air program manages the aging effect loss of Monel 400 material to the diesel generator engine starting air aftercooler tubesheet exposed to a raw water environment. If not, the applicant was requested to explain the intent of statements made in Section 18.2.12.5 of the FSAR supplement, "Diesel Generating Starting Air," which indicates that this program is credited for managing aging of carbon steel, stainless steel, and Monel materials.

In its response dated March 15, 2002, the applicant stated that Table 3.3-24 and Appendix B (B.3.17.5) of the LRA are correct. The Heat Exchanger Preventive Maintenance Activities — Diesel Generator Engine Starting Air is not credited with managing loss of material of the Monel 400 tubesheets of the diesel generator starting air aftercooler. The Service Water Piping Corrosion Program is credited with managing loss of material of the Monel 400 tubesheets of the diesel generator starting air aftercooler, as indicated in Table 3.3-24. Section 18.2.12.5 of the Catawba FSAR supplement is in error and will be revised. The staff has reviewed the

Service Water Piping Corrosion Program and agrees that it will appropriately manage loss of material of the Monel 400 tubesheets. The staff finds that the applicant's response clarifies and satisfactorily resolves this item.

The staff has reviewed the information in Section B.3.17.5 of LRA Appendix B. On the basis of this review and the above evaluation, and with the resolution of SER open item 3.0.3.9.1.2(g), the staff finds that there is reasonable assurance that the applicant has demonstrated that the effects of aging associated with the Preventive Maintenance Activities — Diesel Generator Engine Starting Air Heat Exchangers program 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).

Based on its review of Tables 3.3-23 and 3.3-24 and LRA Appendix B, the staff concludes that the above identified AMPs will effectively manage the aging effects of the diesel generator starting air system, and that there is reasonable assurance that the intended functions of the diesel generator starting air system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.17.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.17; Tables 3.3-23 and 3.3-24; and Section B.3.17.5 of LRA Appendix B. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the diesel generator starting air system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.18 Drinking Water System

3.3.18.1 Technical Information in the Application

No portion of the McGuire drinking water system is within the scope of license renewal. Only the Duke Class F portions of the drinking water system are in scope at Catawba. McGuire has no Class F components in the drinking water system.

The Catawba drinking water system is a municipal water system consisting of a water tower, pumps, and chemical treatment equipment providing chlorinated drinking water to the plant. The drinking water system is a non-safety-related system whose postulated failure could prevent satisfactory accomplishment of certain safety-related functions. To preclude these postulated failures, portions of this system are seismically designed (i.e., Duke Class F). All components within the seismically designed piping boundaries of this system are within the scope of license renewal per 10 CFR 54.4(a)(2).

3.3.18.1.1 Aging Effects

Components of the drinking water system are described in Section 2.3.3.18 of the LRA as being within the scope of license renewal, and subject to an AMR. Table 3.3-25, page 3.3-158, of the LRA lists individual components of the system, including pipes and valve bodies.

Stainless steel components exposed to an internal treated water environment are subject to the aging effects of cracking and loss of material. Exposure of the same stainless steel components to a sheltered external environment has no aging effect.

3.3.18.1.2 Aging Management Programs

The Treated Water Systems Stainless Steel Inspection is utilized to manage aging effects for the drinking water system. A description of the aging management program is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the drinking water system will be adequately managed by the aging management program during the period of extended operation.

3.3.18.2 Staff Evaluation

The applicant described its AMR of the drinking water system for license renewal in two separate sections of its LRA, Section 2.3.3.18 and Table 3.3-25, page 3.3-158. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the drinking water system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.18.2.1 Aging Effects

The aging effects that result from contact of the drinking water SSCs to the environments described in Section 2.3.3.18 and Table 3.3-25, page 3.3-158, of the LRA are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.18.2.2 Aging Management Programs

Section 2.3.3.18 and Table 3.3-25, page 3.3-158, of the LRA state that the Treated Water Systems Stainless Steel Inspection is credited for managing the aging effects in the drinking water system. The Treated Water Systems Stainless Steel Inspection program is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common aging management program. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-25, the staff concludes that the above identified AMP will effectively manage the aging effects of the drinking water system, and that there is reasonable assurance that the intended functions of the drinking water system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.18.3 Conclusions

The staff reviewed the information in Section 2.3.3.18 and Table 3.3-25, page 3.3-158, of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the drinking water system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.19 Fire Protection System

3.3.19.1 Technical Information in the Application

The McGuire and Catawba interior/exterior fire protection systems are essentially the same and perform the same function. The interior/exterior fire protection systems provide fire suppression to protect the capability to shut down the reactor and maintain it in a safe shutdown condition, and to minimize radioactive releases to the environment in the event of a fire. In addition, the system provides water to the condenser circulating water pump and low-level intake pump bearings. McGuire UFSAR Section 9.5.1, "Fire Protection System," provides additional information concerning the McGuire interior/exterior fire protection system. Catawba UFSAR Section 9.5.1, "Fire Protection System," provides additional information concerning the Catawba interior/exterior fire protection system.

3.3.19.1.1 Aging Effects

Components of the fire protection systems are described in Section 2.3.3.19 of the LRA as being within the scope of license renewal and subject to an AMR. The applicant also provided AMR results tables in letters dated October 28, 2002, and November 18, 2002. LRA Tables 3.3-26 and 3.3-27, pages 3.3-159 through 3.3-191, list individual components of the system, including cylinders, tanks, hose racks, flexible hoses, pressure switches, rupture discs, spray nozzles, sprinklers, orifices, dampeners, pump casings, standpipes, pipes, and valve bodies.

Stainless steel components exposed to raw water environments are subject to loss of material. Stainless steel components exposed to ventilation, reactor building, sheltered, and yard environments demonstrate no aging effects. Internal or external surfaces of carbon steel exposed to raw water, sheltered, yard, underground, or reactor building environments demonstrate the aging effect of loss of material. Exposure of carbon steel to ventilation or gas environments has no aging effect. Cast iron components exposed to internal or external raw water, underground, yard, or sheltered environments are subject to loss of material. Cast iron exposed to a ventilation environment is not subject to any aging effects.

Galvanized steel exposed to raw water, yard, underground, or sheltered internal or external environments is subject to loss of material. Internal or external surfaces of galvanized steel exposed to ventilation or embedded environments demonstrate no aging effects. External surfaces of alloy steel exposed to sheltered environments are subject to loss of material. Alloy steel exposed to a gas environment has no aging effect. Brass components exposed to external sheltered, yard, or reactor building environments demonstrate loss of material, while the same components exposed to internal ventilation or gas environments show no aging effects. Brass components exposed to raw water environments are subject to fouling and loss of material.

Copper, malleable iron, and ductile iron components exposed to sheltered environments are subject to loss of material. Exposure of copper, malleable iron, and ductile iron components to ventilation environments demonstrate no aging effects. Bronze components exposed to internal environments of raw water are subject to fouling and loss of material. Bronze components exposed to ventilation, sheltered, or gas environments are not subject to any aging effects. External surfaces of bronze exposed to a sheltered, yard, or reactor building environments are subject to loss of material.

In its response to SER open item 2.3.3.19-2, dated October 28, 2002, the applicant provided the AMR results for fire protection pressure maintenance subsystem SSCs that were identified as within the scope of license renewal. Components of the subsystem include pipes, pump casings, pump strainer housings, strainer baskets, tanks, fire hose racks, and valve bodies. The brass fire hose rack external surface is exposed to a sheltered environment. No aging effects were identified. Loss of material is not an aging effect for this component because the fire hose rack is located in the turbine building and is not subject to any contact with borated water.

In its response to SER open item 2.3.3.19-3, the applicant provided AMR results for the fixed fire suppression equipment to the Catawba lower containment carbon filters. In its response to SER open item 2.3.3.19-6, the applicant provided AMR results for the fixed fire suppression equipment to the Catawba lower containment carbon filters, and for manually operated water spray systems to the McGuire reactor building purge exhaust filters 1A, 1B, 2A, and 2B.

In its response to SER open item 2.3.3.19-5, the applicant provided the following AMR results:

Component Type	**Component Function (Note 1)**	**Material**	**Internal Environment (Note 1)** / **External Environment (Note 2)**	**Aging Effect**	**Aging Management Program and Activity (Note 3)**
Main Fire Pump Strainers	Filtration	Bronze or Stainless Steel	Raw Water (Note 2)	Loss of Material	Fire Protection Program - Main Fire Pump Strainer Inspection

Notes:
(1) Filtration - Provide filtration of process fluid so that downstream equipment and/or environments are protected.
(2) The Main Fire Pump Strainers are located on the suction side of the pumps, totally immersed in raw water.

In its response to SER open item 2.3.3.19-4, dated November 18, 2002, the applicant provided the following AMR results:

Component Type	Component Function	Material	Internal Environment / External Environment	Aging Effect	Aging Management Program and Activity (Note 3)
Fire Hose Rack	Pressure Boundary	Brass	Ventilation	None Identified	None Required
			Sheltered	None Identified	None Required
Piping	Pressure Boundary	Galvanized Steel	Raw Water	Loss of Material	Service Water Piping Corrosion Program Galvanic Susceptibility Program
			Sheltered	None Identified	None Required
Valves	Pressure Boundary	Bronze	Raw Water	Fouling	Fire Protection Program
				Loss of Material	Service Water Piping Corrosion Program
			Sheltered	None Identified	None Required

3.3.19.1.2 Aging Management Programs

The following AMPs are credited to manage aging effects for the interior/exterior fire protection systems:

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program
- Galvanic Susceptibility Inspection
- Service Water Piping Corrosion Program
- Fire Protection Program — Mechanical Fire Protection Component Tests and Inspections
- Selective Leaching Inspection
- Preventive Maintenance Activities — Condenser Circulating Water System Internal Coating Inspection

In letters dated October 28, 2002, and November 18, 2002, the applicant credited the following three new aging management programs:

- Fire Protection Program — Main Fire Pump Strainer Inspection
- Fire Protection Program — Jockey Pump Strainer Inspection
- Fire Protection Program — Tank and Connected Piping Internal Inspection
- Fire Protection Program — Turbine Building Manual Hose Station Flow Test

A description of these aging management programs is provided in Appendix B of the LRA and in October 28, 2002, and November 18, 2002, correspondence from the applicant. The applicant concludes that the effects of aging associated with the components of the interior/exterior fire protection systems will be adequately managed by these aging management programs during the period of extended operation.

3.3.19.2 Staff Evaluation

The applicant described its AMR of the fire protection systems for license renewal in two separate sections of its LRA, Section 2.3.3.19 and Tables 3.3-26 and 3.3-27, pages 3.3-159 through 3.3-191. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the fire protection system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.19.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.19 and Tables 3.3-26 and 3.3-27, pages 3.3-159 through 3.3-191. The staff also reviewed the AMR results tables provided in letters from the applicant dated October 28, 2002, and November 18, 2002. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3.26-1, additional information pertaining to Table 3.3-26, of the LRA, "Aging Management Review Results — Fire Protection System (McGuire Nuclear Station)." This table indicates that sprinklers have a spray flow function. The last sprinkler component in LRA Table 3.3-26 (page 3.3-164) is missing the SP (spray flow) designation. The applicant was requested to correct the table, or justify why the spray flow function is not applicable to these sprinkler entries.

In its response dated March 15, 2002, the applicant stated that the last sprinkler entry in Table 3.3-26 (page 3.3-164) of the LRA should have contained the SP designation. The programs listed for this sprinkler will serve to manage the SP function consistent with other, similar entries in Table 3.3-26 of the LRA. Since the applicant has indicated that the SP function is applicable, the staff finds this response acceptable.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.26-2, additional information pertaining to information in LRA Table 3.3-26, "Aging Management Review Results — Fire Protection System (McGuire Nuclear Station)." Table 3.3-26 states that the fire protection program is credited with managing the aging effect of fouling in raw water environments for carbon steel, brass and bronze valves. Carbon steel, brass, and bronze valve body components are identified in the exterior fire protection section of Table 3.3-26 of the LRA, but fouling has not been identified as an aging effect. The applicant was requested to identify where in the LRA the AMR results are for the aging effect of fouling for these components, or to provide a justification for excluding this aging effect from Table 3.3-26 of the LRA and an AMR.

In its response dated March 15, 2002, the applicant stated that fouling is an applicable aging effect, but only for a specific set of components in the fire protection systems in which a fouled condition could prevent the supply of fire suppression water. As described in Section B.3.12.2, Mechanical Fire Protection Component Tests and Inspections of LRA Appendix B, fouling is managed for specific distribution components of the fire protection systems (sprinklers, hose station valves, and hydrant valves). Managing the impact of fouling on these components ensures that the system is capable of performing its function of supplying fire suppression water through the distribution components. In the interior fire protection system at McGuire, fouling is an applicable aging effect for sprinklers and brass and bronze hose station valves exposed to raw water. In the exterior fire protection system at McGuire, fouling is not an applicable aging effect for the cast iron hydrant valves exposed to raw water because no cast iron hydrant valves are relied upon for fire suppression distribution. This latter point differs from Catawba, where hydrant valves are relied upon for fire suppression distribution, and for which fouling is an applicable aging effect. Since there are no cast iron hydrant valves relied upon for fire suppression distribution at McGuire, the staff finds this response acceptable.

The applicant also stated that, upon further review of Table 3.3-26 of the LRA and consistent with this discussion, an error exists in the McGuire exterior fire protection portion of the table. Fouling should not be an applicable aging effect for the cast iron valve bodies in the yard and exposed to raw water. The LRA Table 3.3-26 entry for the cast iron valve bodies in the yard and exposed to raw water was revised to reflect this. The staff believes that this revision clarifies the item.

By letter dated January 23, 2002, the staff requested, in RAI-3.3.26-3, additional information pertaining to LRA Table 3.3-27, "Aging Management Review Results — Fire Protection System (Catawba Nuclear Station)." This table indicates that Note (4) is applicable in several locations in the table where components are subject to the aging effect fouling. There is no definition for Note (4) at the end of Table 3.3-27. The applicant was requested to clarify if Note (4) is applicable to Table 3.3-27 and, if so, to define it.

In its response dated March 15, 2002, the applicant stated that Note 4 applies to LRA Table 3.3-27. The note was inadvertently omitted from the table notes. Note 4 should read "Fire Hose Rack Valves Only." Upon further review of the LRA Table 3.3-27, an additional notation error was discovered. The fouling entry on page 3.3-189 of the LRA should contain a Note 5 instead of Note 4. Note 5 should read "Fire Hydrant Valves Only." Since the applicant corrected the error, the staff finds that the applicant's response clarifies and satisfactorily resolves this item.

In its response to SER open item 2.3.3.19-2, dated October 28, 2002, the applicant provided the AMR results for fire protection pressure maintenance subsystem SSCs that were identified as within the scope of license renewal. Components of the subsystem include pipes, pump casings, pump strainer housings, strainer baskets, tanks, fire hose racks, and valve bodies. The brass fire hose rack external surface is exposed to a sheltered environment. No aging effects were identified. Loss of material is not an aging effect for this component because the fire hose rack is located in the turbine building, and is not subject to any contact with borated water. For other components of the fire protection pressure maintenance subsystem, the material and environment combinations are the same as those specified in LRA Tables 3.3-26 and 3.3-27. The aging effects identified were consistent with those described in the preceding paragraphs of this SER section.

In its response to SER open item 2.3.3.19-3, the applicant provided AMR results for the fixed fire suppression equipment to the Catawba lower containment carbon filters. In its response to SER open item 2.3.3.19-6, the applicant provided AMR results for the fixed fire suppression equipment to the Catawba lower containment carbon filters, and for manually operated water spray systems to the McGuire reactor building purge exhaust filters 1A, 1B, 2A, and 2B. For both responses, the components, materials, environments, aging effects, and AMPs credited were consistent with those specified in AMR results tables for McGuire and Catawba interior fire protection systems provided in the LRA.

The staff reviewed these AMR results provided in response to SER open item 2.3.3.19-4, and determined that the components, materials, environments, aging effects, and AMPs credited were consistent with those specified in AMR results tables for McGuire and Catawba interior fire protection systems provided in the LRA.

The aging effects that result from contact of the fire protection SSCs to the environments described in LRA Section 2.3.3.19 and LRA Tables 3.3-26 and 3.3-27, and in correspondence from the applicant, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.19.2.2 Aging Management Programs

LRA Section 2.3.3.19 and Tables 3.3-26 and 3.3-27, pages 3.3-159 through 3.3-191, state that the following aging management programs are credited for managing the aging effects in the fire protection system.

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program
- Galvanic Susceptibility Inspection
- Service Water Piping Corrosion Program
- Fire Protection Program — Mechanical Fire Protection Component Tests and Inspections
- Selective Leaching Inspection
- Preventive Maintenance Activities — Condenser Circulating Water System Internal Coating Inspection

In response to SER open items pertaining to scoping and screening of fire protection equipment (documented in Section 2.3.3.19 of this SER), the applicant provided the following AMPs in letters dated October 28, 2002, and November 18, 2002.

- Fire Protection Program — Main Fire Pump Strainer Inspection
- Fire Protection Program — Jockey Pump Strainer Inspection
- Fire Protection Program — Tank and Connected Piping Internal Inspection
- Fire Protection Program — Turbine Building Manual Hose Station Flow Test

The Fluid Leak Management Program, Galvanic Susceptibility Inspection Program, Service Water Piping Corrosion Program, Inspection Program for Civil Engineering Structures and Components, Fire Protection Program, Selective Leaching Inspection Program and Liquid Waste System Inspection Program, and Preventive Maintenance Activities — Condenser Circulating Water System Internal Coating Inspection Program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER. The staff's review of the Fire Protection Program — Mechanical Fire Protection Component Tests and Inspections, the Fire Protection Program — Main Fire Pump Strainer Inspection, the Fire Protection Program — Jockey Pump Strainer Inspection, the Fire Protection Program — Tank and Connected Piping Internal Inspection, and the Fire Protection Program — Turbine Building Manual Hose Station Flow Test follows.

Fire Protection Program — Mechanical Fire Protection Component Tests and Inspections

The applicant described its Mechanical Fire Protection Component Tests and Inspections in Section B.3.12.2 of LRA Appendix B. The applicant credits these activities with managing the potential aging of specific fire protection system components that are within the scope of license renewal. The staff reviewed Section B.3.12.2 of LRA Appendix B to determine whether the applicant has demonstrated that tests and inspections of mechanical fire protection components will adequately manage the applicable effects of aging during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Section B.3.12.2 of LRA Appendix B describes the Mechanical Fire Protection Component Tests and Inspections. The purpose of this program is to manage loss of material and fouling of specific components in the fire protection systems. The program manages loss of material in sprinklers that can affect the pressure boundary and spray functions of the sprinklers. The program also manages fouling of sprinklers, valves at hydrants, and valves at hose racks that can affect the component function. This program is a condition monitoring program that is credited with managing the subject aging effect for brass and bronze materials exposed to a raw water environment.

Operating experience has demonstrated that fouling is an aging effect requiring management for the fire protection systems at McGuire and Catawba. The systems use lake water as their water source. The stations have been working to manage fouling through the use of chemical treatment, testing, and inspections. For the purpose of license renewal, fouling is being applied to the distribution components (sprinklers, hose station valves, and hydrant valves) of the fire protection systems. Managing fouling of the distribution components ensures that the system is capable of performing its function of supplying fire suppression water through the distribution components.

The staff's evaluation of the program focused on how the program manages the aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The LRA indicates that the corrective actions and confirmation process are implemented through the site corrective action program, while the administrative controls are governed by SLCs and implemented through plant procedures and the site work processes. The staff's evaluation of the corrective actions, confirmation process, and administrative controls is provided in Section 3.0.4 of this SER. The remaining seven elements are discussed below.

[Program Scope] The components within the scope of the program are the sprinklers and fire hydrant valves and hose rack valves of the interior and exterior fire protection systems. The staff finds the program scope adequate and acceptable.

[Parameters Monitored or Inspected] The program involves visual inspections to verify sprinkler condition, and flow is monitored during flow tests and flushes of the system to verify that there is no blockage of flow that will prevent system function. The staff finds that visual inspection will detect loss of material due to general, crevice, and pitting corrosion, as well as loss of seal or cracking due to embrittlement. Internal conditions are monitored through the use of leakage, flow, and pressure testing. Internal loss of material (due to general, crevice, and pitting corrosion, microbiologically influenced corrosion, and selective leaching) and blockage due to fouling can be detected by changes in flow or pressure, leakage, or evidence of excessive corrosion products during flushing of the system. The staff finds that the parameters monitored will permit timely detection of the aging effects and are, therefore, acceptable.

[Detection of Aging Effects] The applicant stated that detection of degradation on external surfaces is determined by visual examination. Surfaces of components and structures are examined for damage, deterioration, leakage, or other forms of corrosion. Section B.3.12.2 of LRA Appendix B states that functional testing and flushing of the system clears away internal scale, debris, and other foreign material that could lead to blockage/obstruction of the system. Flow and pressure tests verify system integrity. Visual examination of breached portions of the system also verifies unobstructed flow and integrity of the piping/components. In response to the staff's RAIs, the applicant stated that volumetric examinations will also be performed, as described below. The staff finds the detection of aging effects adequate and acceptable.

[Monitoring and Trending] The program manages loss of material and fouling through visual inspections and system flow tests and flushes.

Section B.3.12.2 of LRA Appendix B states that loss of material of sprinklers is detected through the use of visual inspections. Sprinklers are visually inspected at least once every 18 months in accordance with SLC 16.9.2. Additionally, a sample of sprinklers are either inspected or replaced at 50 years of operation.

By letter dated January 28, 2002, the staff requested, in RAI B.3.12.2-1, the applicant to describe the basis for the sampling process for testing and/or replacement of sprinklers after 50 years of operation. In its response dated March 15, 2002, the applicant indicated that the rationale for replacement or testing comes from NFPA 25 – 1998, Section 2-3.1.1, which states—

> Where sprinklers have been in service for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory acceptable to the authority having jurisdiction for field service testing.

The applicant indicated that samples will be selected based on the different environments (temperature, humidity, etc.) that the sprinklers were exposed to during their 50-year service life. The staff finds the response acceptable because it conforms to NFPA guidelines.

Section B.3.12.2 of LRA Appendix B states that fouling of hose station valves, hydrant valves, and sprinklers is managed by various flow tests and flushes performed on the systems. Distribution loops experience high-volume flow when hydrant valves are periodically opened. This is performed for the outside distribution loop every 6 months, and is governed by SLC 16.9-1(a)(iii) for Catawba and Testing Requirement (TR) 16.9.1.3 for McGuire. Additional distribution loop flow tests are performed by procedure less frequently.

By letter dated January 28, 2002, the staff requested, in RAI B.3.12.2-2, the applicant to clarify the difference between SLC 16.9.1(a)(iii) at Catawba and TR 16.9.1.3 at McGuire, both of which govern the flow tests and flushes of hose station valves and sprinklers. In its response dated March 15, 2002, the applicant stated that the content of the two requirements is the same; they simply have different numbers. McGuire recently converted their SLC to a standardized Technical Specification format, while Catawba has not yet completed their conversion. Therefore, the surveillance numbering scheme is different between the plants' SLCs. The staff finds this clarification reasonable and acceptable.

Section B.3.12.2 of LRA Appendix B states that the integrity of hose station valves and hydrant valve is assured by supplying water to these components. Each hose station valve is opened at least once every 3 years per SLC 16.9-4. Hydrant valves are fully opened every 6 months. The hydrant tests are not governed by SLCs, but are performed by procedure.

Section B.3.12.2 of LRA Appendix B also states that the integrity of the sprinkler branch lines is assured by performing sprinkler system flow tests every 18 months. This procedure is performed by fully opening the inspector's test connection valve, which stimulates flow from the most hydraulically remote sprinkler head on each system. This test is governed by SLC TR 16.9-2(a)(iv)(1) at Catawba. The test is not governed by SLCs at McGuire, but is performed by procedure.

By letter dated January 28, 2002, the staff requested, in RAI B.3.12.2-3, the applicant to clarify why the sprinkler system flow testing for branch lines is governed by SLC TR 16.9-2(a)(iv) at Catawba, but is performed to satisfy a specific plant procedure at McGuire, and not governed by any SLC. In its response dated March 15, 2002, the applicant stated that during original licensing of McGuire, the sprinkler system flow test was not a required TS surveillance. During subsequent Catawba licensing, the surveillance was required to be placed in Technical Specifications. Since it was never in the original McGuire TS, it was not placed into the SLC during the TS conversion. Since the test is committed to as part of an AMP for license renewal, the sprinkler system flow test will be added to the McGuire FSAR supplement. In its response to RAI B.3.12.2-3, the applicant indicated that the FSAR supplement will be revised to include the sprinkler system flow test in accordance with their response to RAI B.3.2.12.2-4, which is discussed in the following paragraphs. The staff finds the clarification reasonable and acceptable because the integrity of the sprinkler branch lines will be ensured by performance of sprinkler system flow tests on a periodic basis.

Section B.3.12.2 of LRA Appendix B states that fouling of sprinkler branch lines that do not receive flow during this test will be managed by a sample disassembly inspection program. Since these lines do not receive flow, it is believed that they are less susceptible to fouling than the lines that receive flow during testing. To validate this belief, branch lines of a few representative sprinkler systems will be disassembled and the piping visually inspected. Subsequent inspections for the period of extended operation will be determined based on inspection results. If fouling is minimal, it is preferable to terminate the sample inspections because draining and filling activities introduce newly oxygenated water to those portions of the systems; this would have an adverse effect on corrosion and fouling of the lines.

By letter dated January 28, 2002, the staff requested, in RAI B 3.12.2-4, the applicant to explain the basis for the sample disassembly inspection program for managing the fouling of sprinkler branch lines. In its response dated March 15, 2002, the applicant stated that, in light of the view that the potential for general corrosion is accelerated by introducing new oxygen to the system when the system is opened, the applicant would revise this aspect of the program, as described in Section B 3.12.2 of LRA Appendix B. Fouling of sprinkler branch lines that do not receive flow during flow tests was to be managed by disassembling the piping and visually inspecting the interior surfaces. The applicant proposes a combination of volumetric examination, such as radiography, and possibly sample disassembly to manage fouling of these branch lines. Some radiography of the fire protection piping has already been performed and provides excellent indication of corrosion product buildup in the lines. The applicant proposed using volumetric examination as a screening tool to determine if it is necessary to perform further intrusive inspections.

The branch line samples to be inspected by volumetric examination will be selected based on several factors. Samples will be chosen to try to obtain a representative sampling of the various environments (temperatures, flow condition, etc.) to which the sprinkler systems have been exposed. Also, samples will be chosen based on pipe configurations that would lend themselves to worst-case fouling (e.g., low points, multiple bends, etc.). The sample size will be determined based on obtaining a representative sample that would bound all of the selection parameters identified in the applicant's response. The applicant further stated that, if volumetric examination results indicate the need to perform further intrusive inspections on a particular branch line, then that branch line will be inspected as described in the Section B 3.12.2 of LRA Appendix B. The applicant indicated that the FSAR supplements would be updated to reflect this use of volumetric examination in this AMP, and to include the sprinkler system flow test in accordance with its response to RAI B.3.2.12.2-3 (previously discussed). The staff finds this response reasonable and acceptable because fouling of sprinkler branch lines that do not receive flow during periodic testing will be monitored by volumetric examination procedures.

By letter dated January 28, 2002, the staff requested, in RAI B.3.12.2-5, the applicant to indicate if its AMP conforms to the following staff position:

> The staff proposes to revise the fire protection program inspection criteria in NUREG-1801 for wall thinning of piping due to corrosion. Each time the system is opened, oxygen is introduced into the system, and this accelerates the potential for general corrosion. Therefore, the staff recommends that a non-intrusive means of measuring wall thickness, such as ultrasonic inspection, be used to detect this aging effect. The staff recommended action in this regard is that, in addition to an ultrasonic inspection of the fire protection piping before exceeding the current licensing term, the applicant perform ultrasonic inspections immediately after the 50-year service life sprinkler head testing, in accordance with NFPA 25, Section 2.3.3.1, and at 10-year intervals thereafter.

In its response dated March 15, 2002, the applicant provided the following:

> The "Service Water Piping Corrosion Program," discussed in Section B 3.29 of the Application, manages wall thinning of piping due to corrosion of Fire Protection systems. The program uses ultrasonic inspection, a non-intrusive method to manage this effect. The nature of the program does not prescribe inspections at the specified times outlined by the staff position, but does ensure reinspection at an appropriate frequency based on the calculated corrosion rate. (See response to RAI B.3.29-2.) The program will likely impose inspections more frequently than that outlined in the staff's position. The program is an existing program with adequate operating experience to provide reasonable assurance that it will manage the aging of fire protection systems as successfully as it has managed other raw water systems in the plant.

The staff finds the applicant's response reasonable and acceptable since it conforms with the proposed staff position on this issue.

By letter dated January 28, 2002, the staff requested, in RAI B 3.12.2-6, the applicant to describe the environmental and material conditions that exist on the interior surface of below-grade fire protection piping. The staff's position is that if these conditions can be demonstrated to be similar to the conditions existing in the above-grade fire protection piping, then the inspections in the above-grade piping may be extrapolated to evaluate the interior conditions of the below-grade piping. If not, additional inspection activities may be needed to provide reasonable assurance that the intended function of below-grade fire protection piping will be maintained consistent with the applicant's licensing basis for the extended operation.

In its March 15, 2002, response, the applicant stated that the environmental conditions of the interior surface of the below-grade fire protection piping are exactly the same as that of the above-grade fire protection piping. The environment is stagnant lake water. The material conditions of the below-grade fire protection piping are different than those of the above-grade fire protection piping. The below-grade fire protection piping is cement-lined, providing it with an added feature to prevent the loss of material of the base metal due to corrosion. The cement lining also prevents internal buildup of turbucles that would contribute to the degradation of the pipe flow characteristics. In addition to the inspection activities, the testing features described in Section B 3.12.2 of LRA Appendix B involve testing on the below-grade, as well as the above-ground, portion of the system to provide assurance that the entire system can perform its intended function. In addition, the applicant has performed intrusive visual inspections of the internal surfaces of the underground cement-lined piping during maintenance of modification work. The condition of the piping is excellent. The internal lining is intact, ensuring the integrity of the base metal. The staff finds the applicant's response reasonable and acceptable.

The staff finds that the applicant's methodology will provide effective monitoring and trending of the aging effects and is, therefore, acceptable.

[Acceptance Criteria] Section B.3.12.2 of LRA Appendix B describes the acceptance criteria for the visual inspections of the sprinklers as, "an evaluation is performed for any cracks, corrosion, missing pipe hangers, obstructions to sprinkler spray pattern, and other piping abnormalities that are detected." The acceptance criteria for system flushes and slow tests are, "water shall flow through the valve to the discharge point with no obvious signs of flow blockage." The staff finds these acceptance criteria acceptable because the effects of aging will be detected and evaluated before loss of intended function would occur.

[Operating Experience] Section B.3.12.2 of LRA Appendix B describes the operating experience as follows:

> McGuire Operating Experience
> Fouling of the fire protection systems is being minimized by chemical treatment of the water. Additionally, system engineers monitor flow through the system headers and attempt to minimize header flow to reduce internal buildup of corrosion products. Flow tests have not detected unacceptable fouling in other areas where flows are limited. Over the past three years, sections of piping have been replaced due to pin-hole leaks or where fouling has been detected during permitted internal inspections. All corrective actions have been taken prior to loss of component intended function.

Catawba Operating Experience
Fouling of the fire protection systems is being minimized in recent years by chemical treatment of the water. Additionally, system engineers monitor flow through the system headers and attempt to minimize header flow to reduce internal buildup of corrosion products. Due to corrosion product buildup in the system, the Interior Fire Protection System auxiliary building header was cleaned in 1996. All corrective actions have been taken prior to loss of component intended function.

The staff finds that the operating experience at McGuire and Catawba indicates that aging of the fire protection system will be effectively managed during the period of extended operation.

FSAR Supplement: The staff has reviewed the UFSAR Section 18.2.8 of Appendix A to the LRA, and has confirmed that it contains the appropriate elements of the program.

In conclusion, the staff reviewed the information provided in Section B.3.12.2 of LRA Appendix B, the summary description provided in the FSAR supplement, and the applicant's March 15, 2002, responses to the staff's RAIs. On the basis of its review, as discussed above, the staff finds that there is reasonable assurance that the Mechanical Fire Protection Component Tests and Inspections will adequately manage the aging effects, such that the intended function(s) will be maintained in accordance with within the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Fire Protection Program — Main Fire Pump Strainer Inspection

In response to open item 2.3.3.19-5, by letter dated October 28, 2002, the applicant submitted the Main Fire Pump Strainer Inspection program. The purpose of this program is to identify any loss of material of each main fire pump strainer in the fire protection system. The program manages loss of material in the fire pump strainers that prevents debris from entering the pump when it is in operation, thus protecting the pump from damage. This program is a condition monitoring program that is credited with managing the subject aging effect for bronze or stainless steel materials exposed to a raw water environment.

Lake water is used to supply the fire protection suppression systems at McGuire and Catawba. Lake water is corrosive and may contain sediment, which can potentially clog the fire pumps. The pumps are normally in standby and are automatically started on low system pressure. Each pump has a ½ inch mesh strainer, which is located on the suction side of the pump and is totally immersed in raw water. Managing loss of material of the strainer ensures that the raw water is filtered to protect the downstream fire protection equipment and/or components.

The staff's evaluation of the program focused on how the program manages the aging effect through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The LRA indicates that the corrective actions and confirmation process are implemented through the site corrective action program, while the administrative controls are governed by SLCs and implemented through plant procedures and the site work processes. The staff's evaluation of the corrective actions, confirmation process, and administrative controls is provided in Section 3.0.4 of this SER. The remaining seven elements are discussed below:

[Program Scope] The scope of the Main Fire Pump Strainer Inspection is the strainer located on the suction bell of each main fire pump. The staff finds the program scope acceptable since the program manages aging for the main fire pump strainers.

[Preventive Actions] No actions are taken as part of this program to prevent aging effects or to mitigate aging degradation. The staffs concurs that no preventive actions are required for this condition monitoring program.

[Parameters Monitored or Inspected] The parameter inspected by the Main Fire Pump Strainer Inspection is loss of material of the stainless steel or bronze strainer due to exposure to a raw water environment. The staff finds the parameter inspected acceptable since inspection of the strainer will detect the presence, and extent, of the aging effect of loss of material.

[Detection of Aging Effects] In accordance with information provided for the Monitoring and Trending element (documented below), the Main Fire Pump Strainer Inspection will detect loss of material of the main fire pump strainers by visual inspection performed prior to loss of component intended function. There is no operating experience for loss of material of these strainers; therefore, the staff finds the visual inspection prior to the end of the current operating term, and at least once every 10 years during the period of extended operation, an acceptable method to detect loss of material in the strainers. The inspection frequency is based on the planned frequency for performing routine maintenance on each main fire pump. If inspections are not acceptable, specific corrective actions will be implemented by the applicant, in accordance with the corrective action program, to ensure the component intended function will be maintained during the period of extended operation. All strainers will be inspected, therefore sampling is not used as an inspection method.

[Monitoring and Trending] The Main Fire Pump Strainer Inspection is a general visual inspection for loss of material of the strainer. The Main Fire Pump Strainer Inspection will be performed at least once every 10 years. For McGuire, the initial Main Fire Pump Strainer Inspection will be completed following issuance of renewed operating licenses for McGuire Nuclear Station, and by June 12, 2021 (the end of the initial license of McGuire Unit 1). For Catawba, the initial Main Fire Pump Strainer Inspection will be completed following issuance of the renewed operating licenses for Catawba Nuclear Station, and by December 6, 2024 (the end of the initial license of Catawba Unit 1). The staff finds that the monitoring (visual inspection) frequency of the strainer which is prior to the end of the current operating term, and at least once every 10 years during the period of extended operation, is acceptable to ensure that the component intended function is maintained during the period of extended operation. No actions are taken as part of this program to trend inspection results.

[Acceptance Criteria] The acceptance criterion for the Main Fire Pump Strainer Inspection is no unacceptable loss of material that could result in a loss of component intended function(s), as determined by engineering evaluation. If engineering evaluation determines that the observed aging effects do not cause a loss of component intended function, then no further actions are necessary. If engineering evaluation determines that the observed aging effects could cause a loss of component intended function, then corrective actions are taken, including cleaning of the strainer or replacement. Specific corrective actions will be implemented in accordance with the corrective action program. The staff finds that no unacceptable loss of material that could result in a loss of component intended function(s), as determined by engineering evaluation, is an adequate acceptance criterion.

[Operating Experience] The Main Fire Pump Strainer Inspection is a new inspection for which there is no operating experience. The inspection frequency is based on the planned frequency for performing routine maintenance on each main fire pump. The Main Fire Pump Strainer Inspection is a new program that will use techniques with demonstrated capability and a proven industry record to identify loss of material in a raw water environment. Similar visual inspections have been used to detect degradation loss of material for piping components. The staff finds the applicant's inspection method acceptable.

FSAR Supplement: The staff has reviewed the USFAR Supplement summary description of the Main Fire Pump Strainer Inspection in the applicant's response to open item 2.3.3.19-5, and has confirmed that it contains the appropriate elements of the program.

In conclusion, the staff reviewed the applicant's October 28, 2002, response to open item 2.3.3.19-5. On the basis of this review, as discussed above, the staff finds that there is reasonable assurance that the Main Fire Pump Strainer Inspection will adequately manage the aging effects, such that the intended functions will be maintained in accordance with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Fire Protection Program — Jockey Pump Strainer Inspection

In response to open item 2.3.3.19-2, by letter dated October 28, 2002, the applicant submitted the Jockey Pump Strainer Inspection program. The purpose of the Jockey Fire Pump Strainer Inspection is to identify loss of material of each stainless steel jockey pump strainer basket. A strainer is located at the suction side of each jockey pump. Raw water flow could result in loss of material of the strainer. This activity visually inspects the condition of the strainer baskets every 10 years to check for loss of material. The Jockey Pump Strainer Inspection is a condition monitoring activity and is a new plant activity for license renewal.

The staff's evaluation of the program focused on how the program manages the aging effect through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The LRA indicates that the corrective actions and confirmation process are implemented through the site corrective action program, while the administrative controls are governed by SLCs and implemented through plant procedures and the site work processes. The staff's evaluation of the corrective actions, confirmation process, and administrative controls is provided in Section 3.0.4 of this SER. The remaining seven elements are discussed below:

[Scope] The scope of the Jockey Pump Strainer Inspection is the strainer located on the suction side of each jockey pump. The staff finds the program scope acceptable since the program manages aging for the jockey pump strainers.

[Preventive Actions] No actions are taken as part of this program to prevent aging effects or to mitigate aging degradation. The staff concurs that no preventive actions are required for this condition monitoring program.

[Parameters Monitored or Inspected] The parameter inspected by the Jockey Fire Pump Strainer Inspection is loss of material due to exposure to a raw water environment. The staff finds the parameter inspected acceptable since inspection of the stainless steel strainer will detect the presence, and extent, of the aging effect of loss of material.

[Detection of Aging Effects] In accordance with information provided for the Monitoring and Trending element (documented below), the Jockey Pump Strainer Inspection will detect loss of material of the jockey pump strainers prior to loss of component intended function. Operating experience has not identified loss of material for the jockey pump strainers. Therefore, the staff finds the visual inspection prior to the end of the current operating term, and at least once every 10 years during the period of extended operation, an acceptable method to detect loss of material in the strainers. If inspections are not acceptable, specific corrective actions will be implemented by the applicant, in accordance with the corrective action program, to ensure that the component intended function will be maintained during the period of extended operation. All strainers will be inspected; therefore, sampling is not used as an inspection method.

[Monitoring and Trending] The Jockey Pump Strainer Inspection is a general visual inspection for loss of material of the strainer baskets. For McGuire, the initial Jockey Pump Strainer Inspection will be completed following issuance of renewed operating licenses for McGuire Nuclear Station, and by June 12, 2021 (the end of the initial license of McGuire Unit 1). For Catawba, the initial Jockey Pump Strainer Inspection will be completed following issuance of renewed operating licenses for Catawba Nuclear Station, and by December 6, 2024 (the end of the initial license of Catawba Unit 1). The staff finds that the monitoring (visual inspection) frequency of the strainer, which is prior to the end of the current operating term, and at least once every 10 years during the period of extended operation, is acceptable to ensure that the component intended function is maintained during the period of extended operation. No actions are taken as part of this program to trend inspection results.

[Acceptance Criteria] The acceptance criterion for the Jockey Pump Strainer Inspection is no unacceptable loss of material that could result in a loss of component intended function(s), as determined by engineering evaluation. If engineering evaluation determines that the observed aging effects do not cause a loss of component intended function, then no further actions are necessary. If engineering evaluation determines that the observed aging effects could cause a loss of component intended function, then corrective actions are taken, including cleaning of the strainer or replacement. Specific corrective actions will be implemented in accordance with the corrective action program. The staff finds that no unacceptable loss of material that could result in a loss of component intended function(s), as determined by engineering evaluation, is an adequate acceptance criterion.

[Operating Experience] The Jockey Pump Strainer Inspection is a new inspection. Visual inspection is an effective method for detecting age-related degradation in the strainers. The strainers have been cleaned periodically through the years and loss of material has not been observed. The staff finds that the applicant's operating experience provides objective evidence to support the conclusion that the effects of aging will be managed adequately, so that the strainers intended function will be maintained during the period of extended operation.

FSAR Supplement: The staff has reviewed the USFAR Supplement summary description of the Jockey Pump Strainer Inspection in the applicant's response to open item 2.3.3.19-2, and has confirmed that it contains the appropriate elements of the program.

In conclusion, the staff reviewed the applicant's October 28, 2002, response to open item 2.3.3.19-2. On the basis of this review, as discussed above, the staff finds that there is reasonable assurance that the Jockey Pump Strainer Inspection will adequately manage the aging effects, such that the intended functions will be maintained in accordance with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Fire Protection Program — Tank and Connected Piping Internal Inspection

In response to open item 2.3.3.19-2, by letter dated October 28, 2002, the applicant submitted the Tank and Connected Piping Internal Inspection program. The purpose of the Tank and Connected Piping Internal Inspection is to manage loss of material of the internal surfaces of the carbon steel tanks and some connecting piping and valves in the Fire Protection System at McGuire and Catawba and the Filtered Water System at Catawba. The internal carbon steel surfaces of the tanks within the scope of this inspection are coated with an epoxy coating. Continued presence of an intact coating precludes loss of material of the internal surfaces of the carbon steel tanks that could lead to loss of pressure boundary function. This activity inspects the internal coating of the tanks every 10 years to check the condition of the coating to identify coating failures, and inspects some of the connected piping for loss of material. The Tank and Connected Piping Internal Inspection is a condition monitoring activity.

The staff's evaluation of the program focused on how the program manages the aging effect through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience. The LRA indicates that the corrective actions and confirmation process are implemented through the site corrective action program, while the administrative controls are governed by SLCs and implemented through plant procedures and the site work processes. The staff's evaluation of the corrective actions, confirmation process, and administrative controls is provided in Section 3.0.4 of this SER. The remaining seven elements are discussed below:

[Scope] The scope of the Tank and Connected Piping Internal Inspection is the internal surface of the McGuire fire protection system pressure maintenance accumulator tank and the connecting piping and valves that supply high-pressure air. The scope of the program at Catawba is the equivalent fire protection system pressure maintenance accumulator tank. Additionally, at Catawba, the filtered water tanks, and their connected aluminum piping in the supply system to the fire protection system, will be inspected. The staff finds the program scope acceptable since the program manages aging of the internal surfaces of the tanks and piping for loss of material. Included in the program are the accumulator tank and connecting high-pressure air piping and valves at McGuire, and the accumulator tank and the filtered water tanks and connecting aluminum piping at Catawba.

[Preventive Actions] No actions are taken as part of this program to prevent aging effects or to mitigate aging degradation. The staffs concurs that no preventive actions are required for this condition monitoring program.

[Parameters Monitored or Inspected] The Tank and Connected Piping Internal Inspection inspects the coating for signs of blistering, chipping, peeling, and missing coating, as well as signs of corrosion of the underlying carbon steel tanks. The inspection also visually inspects the high-pressure air supply piping connected to the fire protection system pressure maintenance accumulator tank at McGuire, and the aluminum piping connected to the filtered water tanks at Catawba, for signs of loss of material. Due to the material and environment of this connecting piping, little to no aging effects are expected in these latter components, which will be verified by this inspection. The staff finds the parameters inspected are acceptable since a visual inspection of the tanks and piping will detect the condition of the tank coatings and any loss of material of connecting piping and valves.

[Detection of Aging Effects] In accordance with the information provided for the Monitoring and Trending element (documented below), the Tank and Connected Piping Internal Inspection will detect the condition of the tank coatings and any loss of material of connecting piping. Previous visual inspections of the McGuire tank and a similar tank at Catawba have demonstrated that visual inspection of internal surfaces is an effective method for detecting age-related degradation in the tanks and associated piping and valves. Therefore, the staff finds the visual inspection prior to the end of the current operating term, and at least once every 10 years during the period of extended operation, an acceptable method to detect the condition of the tank coatings and any loss of material of connecting piping.

[Monitoring and Trending] The Tank and Connected Piping Internal Inspection visually inspects the internal coating of the tanks. The inspection looks for signs of blistering, chipping, peeling, and missing paint as well as signs of corrosion of the underlying carbon steel tank. The inspection also visually inspects connecting piping described in Parameters Monitored or Inspected for signs of loss of material. No actions are taken as part of this activity to trend inspection results. For McGuire, the initial Tank and Connected Piping Internal Inspection will be completed following issuance of renewed operating licenses for McGuire Nuclear Station, and by June 12, 2021 (the end of the initial license of McGuire Unit 1). For Catawba, the initial Tank and Connected Piping Internal Inspection will be completed following issuance of renewed operating licenses for Catawba Nuclear Station, and by December 6, 2024 (the end of the initial license of Catawba Unit 1). The staff finds that the monitoring (visual inspection) frequency of the tanks and associated piping and valves which is prior to the end of the current operating term, and at least once every 10 years during the period of extended operation, is acceptable to ensure that the component intended function is maintained during the period of extended operation.

[Acceptance Criteria] The acceptance criteria for the Tank and Connected Piping Internal Inspection are no visual indications of coating defects that have led to corrosion of the underlying carbon steel tank surfaces, and no unacceptable loss of material of the connecting piping that could result in an unacceptable loss of pressure boundary, as determined by engineering evaluation. Unacceptable loss is defined using a high tolerance in this case, since leakage of the pressure maintenance subsystem of the fire protection system can be tolerated and only serves to make the system less efficient, but does not cause a failure of the system to accomplish its intended function. The staff finds that no visual indications of coating defects that have led to corrosion of the underlying carbon steel tank surfaces, and no unacceptable loss of material of the connecting piping that could result in an unacceptable loss of pressure boundary, as determined by engineering evaluation, are adequate acceptance criteria.

[Operating Experience] The Tank and Connected Piping Internal Inspection is a new inspection. Previous visual inspections of the McGuire tank and a similar tank at Catawba have demonstrated that visual inspection of internal surfaces is an effective method for detecting age-related degradation in the tanks and associated piping and valves. The staff finds the applicant's operating experience provides objective evidence to support the conclusion that the effects of aging will be managed adequately, so that the tank and associated piping intended function will be maintained during the period of extended operation.

FSAR Supplement: The staff has reviewed the USFAR Supplement summary description of the Tank and Connected Piping Internal Inspection in the applicant's response to open item 2.3.3.19-2, and has confirmed that it contains the appropriate elements of the program.

In conclusion, the staff reviewed the applicant's October 28, 2002, response to open item 2.3.3.19-2. On the basis of this review, as discussed above, the staff finds that there is reasonable assurance that the Tank and Connected Piping Internal Inspection will adequately manage the aging effects, such that the intended functions will be maintained in accordance with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Fire Protection Program — Turbine Building Manual Hose Station Flow Test

In a letter dated November 18, 2002, the applicant provided additional information in response to SER open item 2.3.3.19-4. In its response, the applicant proposed to address fouling of valves in the turbine building manual hose stations by supplementing the Mechanical Fire Protection Component Tests and Inspections program with the Turbine Building Manual Hose Station Flow Test activity. This new activity of the Mechanical Fire Protection Component Tests and Inspections program involves the opening of turbine building hose station valves that are within the scope of license renewal at least once every 3 years. The turbine building valve tests are not governed by SLCs, but will be performed by procedure. The applicant indicated that this activity is synonymous with the Mechanical Fire Protection Component Tests and Inspections activity already credited for other hose stations within the scope of license renewal.

The staff has reviewed the Mechanical Fire Protection Component Tests and Inspections activity and found that there is reasonable assurance that this activity will adequately manage the aging effects, such that the intended function(s) will be maintained in accordance with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). Therefore, the staff concludes that the Mechanical Fire Protection Component Tests and Inspections activity is an acceptable program for turbine building manual hose station valves as well. By augmenting the Mechanical Fire Protection Component Tests and Inspections activity, the staff finds that there is reasonable assurance that this activity will adequately manage the aging effects of the turbine building manual hose stations (particularly fouling of the manual hose rack valves), such that the intended function(s) will be maintained in accordance with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Based on its review of LRA Tables 3.3-26 and 3.3-27, Appendix B, and in correspondence from the applicant , the staff concludes that the above identified AMPs will effectively manage the aging effects of the fire protection system, and that there is reasonable assurance that the intended functions of the fire protection system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.19.3 Conclusions

The staff reviewed the information in Section 2.3.3.19; Tables 3.3-26 and 3.3-27; Section B.3.12.2 of LRA Appendix B; and information provided by the applicant in letters dated October 28, 2002, and November 18, 2002. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the fire protection system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.20 Fuel Handling Building Ventilation System

3.3.20.1 Technical Information in the Application

The fuel handling building ventilation system is essentially the same, and performs the same function, for McGuire and Catawba. The fuel handling building ventilation system maintains ventilation in the spent fuel pool buildings of Units 1 and 2 to permit personnel access. The exhaust portion of the fuel handling building ventilation system controls airborne radioactivity in the fuel pool area during normal operation, anticipated operational transients, and following postulated fuel handling accidents. McGuire UFSAR Section 9.4.2, "Auxiliary Building," provides additional information concerning the McGuire fuel handling building ventilation system. Catawba UFSAR Section 9.4.2, "Fuel Building Ventilation System," provides additional information concerning the Catawba fuel handling area ventilation system.

3.3.20.1.1 Aging Effects

Components of the fuel handling building ventilation system are described in Section 2.3.3.20 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-28, pages 3.3-192 through 3.3-193, lists individual components of the system, including air flow monitors, ductwork, filters, tubing, and valve bodies. Exposure of carbon steel, galvanized steel, copper, and brass to a sheltered external environment is subject to loss of material. These same components exposed to ventilation internal environments are not subject to any aging effects. Exposure of internal or external surfaces of stainless steel components to ventilation or sheltered environments has no aging effect.

3.3.20.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the fuel handling building ventilation system:

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the fuel handling building ventilation system will be adequately managed by these aging management programs during the period of extended operation.

3.3.20.2 Staff Evaluation

The applicant described its AMR of the fuel handling building ventilation system for license renewal in two separate sections of its LRA, Section 2.3.3.20 and Table 3.3-28, pages 3.3-192 through 3.3-193. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the fuel handling building ventilation system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.20.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.20 and Tables 3.3-28, pages 3.3-192 through 3.3-193. The staff notes that RAI 3.3-1, pertaining to aging management of elastomer components associated with ventilation systems, applies to the fuel handling building ventilation system. However, the staff concluded that this RAI was resolved (see Section 3.3.39.3 of this SER).

In a letter dated November 14, 2002, the applicant submitted its response to SER open item 2.3-3 pertaining to the applicant's treatment of structural sealants (subcomponents of structural members) in certain ventilation system applications for which pressure boundary integrity was an intended function. The applicant identified cracking and shrinkage of structural sealants in the interface between a structural wall, floor, or ceiling and a nonstructural component (such as a duct, piping, electrical cables, doors, and nonstructural walls) resulting from exposure to ambient conditions as potential aging effects.

On the basis of its review, the staff finds that the aging effects that result from contact of the fuel handling building ventilation SSCs to the environments described in LRA Section 2.3.3.20, Table 3.3-28, pages 3.3-192 through 3.3-193, and in correspondence from the applicant, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.20.2.2 Aging Management Programs

LRA Section 2.3.3.20 and Table 3.3-28, pages 3.3-192 through 3.3-193, state that the following aging management programs are credited for managing the aging effects in the fuel handling building ventilation system.

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program

In its November 14, 2002, response to SER open item 2.3-3, the applicant identified the Ventilation Area Pressure Boundary Sealants Inspection to manage the effects of cracking and shrinkage of structural sealant due to exposure to ambient conditions.

The Fluid Leak Management Program, Inspection Program for Civil Engineering Structures and Components, and Ventilation Area Pressure Boundary Sealants Inspection are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-28 and correspondence from the applicant, the staff concludes that the above identified AMPs will effectively manage the aging effects of the fuel handling building ventilation system, and that there is reasonable assurance that the intended functions of the fuel handling ventilation system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.20.3 Conclusions

The staff reviewed the information in Section 2.3.3.20 and Table 3.3-28 of the LRA. The staff also reviewed correspondence from the applicant. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the fuel handling building ventilation system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.21 Groundwater Drainage System

3.3.21.1 Technical Information in the Application

The groundwater drainage system is essentially the same, and performs the same function, for McGuire and Catawba. The groundwater drainage system prevents hydrostatic loads on the reactor and auxiliary building substructures. The groundwater drainage system maintains an acceptable groundwater level for the auxiliary building by transferring water out of the auxiliary building, and mitigates the consequences of certain postulated flooding events. McGuire UFSAR Section 9.5.8, "Groundwater Drainage System," provides additional information concerning the McGuire groundwater drainage system. Catawba UFSAR Section 9.5.11, "Groundwater Drainage System," provides additional information concerning the Catawba groundwater drainage system.

3.3.21.1.1 Aging Effects

Components of the groundwater drainage system are described in LRA Section as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-29, pages 3.3-194 to 3.3-196, lists individual components of the system, including pump casings, pipe, orifices, tubing, and valve bodies. Stainless steel components are identified as being subject to the external environments of sheltered and yard with no aging effects identified. An internal environment of raw water causes the aging effect of loss of material in stainless steel components. Carbon steel components are subject to the aging effect of loss of material from internal and external surfaces from raw water and sheltered environments. Carbon steel components are identified as embedded in concrete with no external aging effects identified. Cast iron components are subject to the aging effect of loss of material on internal and external surfaces from raw water and sheltered environments.

3.3.21.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the groundwater drainage system:

- Inspection Program for Civil Engineering Structures and Components
- Selective Leaching Inspection (MNP only)
- Galvanic Susceptibility Inspection
- Fluid Leak Management Program
- Sump Pump System Inspection

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the groundwater drainage system will be adequately managed by these aging management programs during the period of extended operation.

3.3.21.2 Staff Evaluation

The applicant described its AMR of the groundwater drainage system for license renewal in two separate sections of its LRA, Section 2.3.3.21 and Table 3.3-29, pages 3.3-194 to 3.3-196. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the groundwater drainage system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.21.2.1 Aging Effects

The aging effects that result from contact of the groundwater drainage SSCs to the environments described in LRA Section 2.3.3.21 and Table 3.3-29, pages 3.3-194 through 3.3-196, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.21.2.2 Aging Management Programs

LRA Section 2.3.3.21 and Table 3.3-29, pages 3.3-194 to 3.3-196, state that the following aging management programs are credited for managing the aging effects in the groundwater drainage system.

- Inspection Program for Civil Engineering Structures and Components
- Selective Leaching Inspection (McGuire only)
- Galvanic Susceptibility Inspection
- Fluid Leak Management Program
- Sump Pump System Inspection

The Fluid Leak Management Program, Galvanic Susceptibility Inspection program, Sump Pump System Inspection program, Inspection Program for Civil Engineering Structures and Components, and Selective Leaching Inspection program (McGuire only) are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-29, the staff concludes that the above identified AMPs will effectively manage the aging effects of the groundwater drainage system, and that there is reasonable assurance that the intended functions of the groundwater drainage system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.21.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.21 and Table 3.3-29, pages 3.3-194 to 3.3-196. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the groundwater drainage system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.22 Hydrogen Bulk Storage System

3.3.22.1 Technical Information in the Application

The hydrogen bulk storage system is essentially the same, and performs the same function, for McGuire and Catawba. The hydrogen bulk storage system supplies hydrogen to the volume control tank (CVCS). The hydrogen bulk storage system is a non-safety-related system whose postulated failure could prevent satisfactory accomplishment of certain safety-related functions. To preclude these postulated failures, portions of this system are seismically designed (i.e., Duke Class F). All components within the seismically designed piping boundaries of this system are within the scope of license renewal per 10 CFR 54.4(a)(2).

3.3.22.1.1 Aging Effects

Components of the hydrogen bulk storage system are described in Section 2.3.3.22 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-30, pages 3.3-197 to 3.3-198, lists individual components of the system, including pipe, tubing, and valve bodies. Stainless steel components are identified as being subject to the internal environment of gas, and external environments of sheltered and yard with no aging effects identified. Carbon steel components are subject to the aging effect of loss of material from external surfaces exposed to sheltered environments. Carbon steel components are identified as being subject to the internal environment of gas with no aging effects identified. Brass components are subject to the aging effect of loss of material from external surfaces from exposure to sheltered environments. Internal surfaces of brass components exposed to gas are not subject to any aging effects. Copper components are subject to the aging effect of loss of material from external surfaces from exposure to sheltered environments. Internal surfaces of copper components exposed to gas are not subject to any aging effects.

3.3.22.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the hydrogen bulk storage system:

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the hydrogen bulk storage system will be adequately managed by these aging management programs during the period of extended operation.

3.3.22.2 Staff Evaluation

The applicant described its AMR of the hydrogen bulk storage system for license renewal in two separate sections of its LRA, Section 2.3.3.22 and Table 3.3-30, pages 3.3-197 to 3.3-198. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the hydrogen bulk storage system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.22.2.1 Aging Effects

The aging effects that result from contact of the hydrogen bulk storage SSCs to the environments described in LRA Section 2.3.3.22 and Table 3.3-30, pages 3.3-197 through 3.3-198, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.22.2.2 Aging Management Programs

LRA Section 2.3.3.22 and Table 3.3-30, pages 3.3-197 to 198, state that the following aging management programs are credited for managing the aging effects in the hydrogen bulk storage system.

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program

The Fluid Leak Management Program, and the Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-30, the staff concludes that the above identified AMPs will effectively manage the aging effects of the hydrogen bulk storage system, and that there is reasonable assurance that the intended functions of the hydrogen bulk storage system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.22.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.22 and Table 3.3-30, pages 3.3-197 to 3.3-198. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the hydrogen bulk storage system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.23 Instrument Air System

3.3.23.1 Technical Information in the Application

The McGuire instrument air system provides dry, oil-free air for instrumentation, testing, and control air requirements. McGuire UFSAR Section 9.3.1, "Compressed Air Systems," provides additional information concerning the McGuire instrument air system.

The Catawba instrument air system supplies clean, oil-free, dried, compressed air to all air-operated instrumentation and valves for both units. Catawba UFSAR Section 9.3.1, "Compressed Air System," provides additional information concerning the Catawba instrument air system.

3.3.23.1.1 Aging Effects

Components of the instrument air system are described in Section 2.3.3.23 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-31, pages 3.3-199 to 3.3-201, lists individual components of the system, including filters, accumulators, tanks, pipe, tubing, and valve bodies. Stainless steel components are identified as being subject to an internal environment of air, and an external environment that is sheltered or in the reactor building, with no aging effects identified. Carbon steel components are subject to the aging effect of loss of material from external surfaces exposed to sheltered environments. Carbon steel components are identified as being subject to the internal environment of air with no aging effects identified. Galvanized steel components are subject to the aging effect of loss of material from external surfaces exposed to sheltered environments. Galvanized steel components are identified as being subject to the internal environment of air with no aging effects identified. Brass components are subject to the aging effect of loss of material on external surfaces from exposure to sheltered environments. Internal surfaces of brass components exposed to air are not subject to any aging effects. Copper components are subject to the aging effect of loss of material from external surfaces from exposure to sheltered environments. Internal surfaces of copper components exposed to air are not subject to any aging effects.

3.3.23.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the instrument air system:

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the instrument air system will be adequately managed by these aging management programs during the period of extended operation.

3.3.23.2 Staff Evaluation

The applicant described its AMR of the instrument air system for license renewal in two separate sections of its LRA, Section 2.3.3.23 and Table 3.3-31, pages 3.3-199 to 3.3-201. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the instrument air system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.23.2.1 Aging Effects

The aging effects that result from contact of the instrument air SSCs to the environments described in LRA Section 2.3.3.23 and Table 3.3-31, pages 3.3-199 through 3.3-201, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.23.2.2 Aging Management Programs

LRA Section 2.3.3.23 and Table 3.3-31, pages 3.3-199 to 3.3-201, state that the following aging management programs are credited for managing the aging effects in the instrument air system.

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program

The Fluid Leak Management Program, and the Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-31, the staff concludes that the above identified AMPs will effectively manage the aging effects of the instrument air system, and that there is reasonable assurance that the intended functions of the instrument air system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.23.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.23 and Table 3.3-31, pages 3.3-199 to 3.3-201. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the instrument air system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.24 Liquid Waste System

3.3.24.1 Technical Information in the Application

The McGuire liquid waste recycle and liquid waste monitor and disposal systems collect, segregate, and process the reactor-grade and non-reactor-grade liquid wastes produced during station operation, refueling, or maintenance. Portions of the liquid waste recycle system function as part of the RCS leakage detection systems. McGuire UFSAR Section 11.2, "Liquid Waste System," provides additional information concerning the McGuire liquid waste recycle and liquid waste monitor and disposal systems.

The Catawba liquid radwaste system collects, segregates, and processes all radioactive and potentially radioactive liquids generated in the plant. In general, all reactor-grade liquids are recycled and all non-reactor-grade liquids are processed and disposed of in accordance with applicable NRC regulations. The system is designed to control and minimize releases of radioactivity to the environment. Catawba UFSAR Section 11.2, "Liquid Radwaste System," provides additional information concerning the Catawba liquid radwaste system.

3.3.24.1.1 Aging Effects

Components of the liquid waste system are described in Section 2.3.3.24 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-32, pages 3.3-202 to 3.3-208, lists individual components of the system, including tanks, pumps, pipe, orifices, separators, strainers, tubing, and valve bodies. Stainless steel components are identified as being subject to the external environments of sheltered and reactor building with no aging effects identified. An internal environment of raw water, borated water, and treated water causes the aging effect of loss of material in stainless steel components. Cracking in stainless steel is also caused by exposure of internal surfaces to borated water and treated water. Internal surfaces of stainless steel components are also subject to the aging effects of cracking (wet/dry) and loss of material (wet/dry) from exposure to a treated water environment. Internal surfaces of stainless steel components exposed to ventilation or gas environments are not subject to any aging effects. Carbon steel components are subject to the aging effect of loss of material from internal environments of raw water and treated water, and external surfaces to the environments of reactor building and sheltered environments. Carbon steel components are identified as being subject to the internal environment of gas with no aging effects identified.

3.3.24.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the liquid waste recycle and liquid waste monitor and disposal systems:

- Inspection Program for Civil Engineering Structures and Components
- Galvanic Susceptibility Inspection
- Fluid Leak Management Program
- Liquid Waste Inspection
- Chemistry Control Program
- Flow-Accelerated Corrosion Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the liquid waste recycle and liquid waste monitor and disposal systems will be adequately managed by these aging management programs during the period of extended operation.

3.3.24.2 Staff Evaluation

The applicant described its AMR of the liquid waste systems for license renewal in two separate sections of its LRA, Section 2.3.3.24 and Table 3.3-32, pages 3.3-202 to 3.3-208. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the liquid waste systems will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.24.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.24 and Table 3.3-32, pages 3.3-202 to 3.3-208. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3.32-1, additional information pertaining to Table 3.3-32, "Aging Management Review Results — Liquid Waste System." This table indicates that stainless steel piping and loop seals at the McGuire plant have the aging effect of loss of material and cracking due to exposure to wet/dry conditions. The applicant was requested to identify where in the LRA the AMR for the wet/dry aging effect is, and explain how the effect is managed by the Chemistry Control Program, or to provide a justification for excluding this environment/aging effect from LRA Table 3.3-32.

In its response dated March 15, 2002, the applicant stated that the aging management review results for the liquid waste systems are presented in Table 3.3-32 of the LRA. The components exposed to an alternate wet and dry environment are piping and valves associated with the loop seal shown on drawing MCFD-1565-03.00 at coordinate D-4, and drawing MCFD-2565-03.00 at coordinates L-3. The seal is established by the addition of demineralized water from the demineralized water system to the loop. Loss of material and cracking could occur as a result of the concentration of contaminants from alternate wetting and drying. Demineralized water contains minimal, if any, contaminants and is monitored and controlled by the Chemistry Control Program. Monitoring and controlling the quality of demineralized water used in plant systems, such as the liquid waste system loop seal, will minimize contaminant levels, such that concentrations that could pose a concern can not be achieved through alternate wetting and drying. Therefore, the Chemistry Control Program will mitigate loss of material and cracking of the loop seal components exposed to alternate wetting and drying from demineralized water by monitoring and maintaining the water quality of the demineralized water system. Since the applicant reviewed the aging effect and credits the Chemistry Control Program to manage it, the staff finds its response acceptable.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.32-2, additional information pertaining to LRA Table 3.3-32, "Aging Management Review Results — Liquid Waste System." This table identifies the aging effect of loss of material and cracking of stainless steel due to exposure to wet/dry conditions. The applicant was requested to clarify if this aging effect is also applicable to the sump pump components identified in LRA Table 3.3-32.

In its response dated March 15, 2002, the applicant stated that Table 3.3-32 of the LRA identified loss of material and cracking of stainless steel pipe and valves at McGuire due to exposure to alternate wet/dry conditions in a treated water environment. Loss of material and cracking of stainless steel due to exposure to wet/dry conditions does not apply to the sump pump components identified in LRA Table 3.3-32. The sump pump components are exposed to a raw water environment only. Since the applicant clarified that the sump pump components are exposed to a raw water environment only, the staff finds its response acceptable.

The staff finds that the applicant's responses clarify and satisfactorily resolve these items. The aging effects that result from contact of the liquid waste SSCs to the environments described in LRA Section 2.3.3.24 and Table 3.3-32, pages 3.3-202 through 3.3-208, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.24.2.2 Aging Management Programs

LRA Section 2.3.3.24 and Table 3.3-32, pages 3.3-202 to 3.3-208, state that the following aging management programs are credited for managing the aging effects in the liquid waste systems.

- Inspection Program for Civil Engineering Structures and Components
- Galvanic Susceptibility Inspection
- Fluid Leak Management Program
- Liquid Waste Inspection
- Chemistry Control Program
- Flow-Accelerated Corrosion Program

The Fluid Leak Management Program, Galvanic Susceptibility Inspection Program, Chemistry Control Program, Inspection Program for Civil Engineering Structures and Components, Flow-Accelerated Corrosion Program, and Liquid Waste System Inspection program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-32, the staff concludes that the above identified AMPs will effectively manage the aging effects of the liquid waste systems, and that there is reasonable assurance that the intended functions of the liquid waste systems will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.24.3 Conclusions

The staff reviewed the information in Section 2.3.3.24 and Table 3.3-32 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the liquid waste systems will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.25 Miscellaneous Structures Ventilation System

3.3.25.1 Technical Information in the Application

The turbine building ventilation system at McGuire performs the corresponding functions as the miscellaneous structures ventilation system at Catawba.

The Catawba miscellaneous structures ventilation system includes the standby shutdown facility (SSF) HVAC. The SSF HVAC portion of the miscellaneous structures ventilation system provides the environmental controls necessary to ensure that SSF equipment is maintained operable during postulated fires and station blackout.

Components of the miscellaneous structures ventilation system are described in Section 2.3.3.25 of the LRA as being within the scope of license renewal, and subject to an AMR. Table 3.3-33, page 3.3-209, of the LRA lists individual components of the system, including air handling units, ductwork, flexible connectors, and plenum sections. Galvanized steel components exposed to an internal environment of ventilation and sheltered environments are not subject to any aging effects. Neoprene components exposed to ventilation and sheltered environments are not subject to any aging effects.

No AMPs are required to manage aging effects for the miscellaneous structures ventilation system.

3.3.25.2 Staff Evaluation

The applicant described its AMR of the miscellaneous structures ventilation system for license renewal in two separate sections of its LRA, Section 2.3.3.25 and Table 3.3-33, page 3.3-209. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the miscellaneous structures ventilation system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.25.2.1 Aging Effects

The applicant's conclusion that no aging effects result from contact of the miscellaneous structures ventilation SSCs to the environments listed in Section 2.3.3.25 and Table 3.3-33, page 3.3-209, of the LRA is consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff agrees with the applicant that there are no aging effects for the combination of materials and environments identified.

3.3.25.2.2 Aging Management Programs

There are no aging effects identified in this system. Therefore, no AMPs are required in the miscellaneous structures ventilation system.

3.3.25.3 Conclusions

The staff reviewed the information in Section 2.3.3.25 and Table 3.3-33, page 3.3-209, of the LRA. On the basis of its review, the staff concludes that the SCs in the miscellaneous structures ventilation system are not subject to any aging effects. Therefore, no AMPs are required in the miscellaneous structures ventilation system.

3.3.26 Nitrogen System

3.3.26.1 Technical Information in the Application

The McGuire nitrogen system provides a safety-related supply of nitrogen to the pneumatic actuators on the feedwater isolation valves.

The Catawba nitrogen system is a non-safety-related system whose postulated failure could prevent satisfactory accomplishment of certain safety-related functions. To preclude these postulated failures, portions of this system are seismically designed (i.e., Duke Class F). All components within the seismically designed piping boundaries of these systems are within the scope of license renewal per 10 CFR 54.4(a)(2).

Components of the nitrogen system are described in Section 2.3.3.26 of the LRA as being within the scope of license renewal, and subject to an AMR. Table 3.3-34, page 3.3-210, of the LRA lists individual components of the system, including tanks, pipe, tubing, and valve bodies. Stainless steel components exposed to a gas internal environment and a sheltered external environment are not subject to any aging effects.

3.3.26.1.2 Aging Management Programs

No AMPs are required to manage aging effects for the nitrogen system.

3.3.26.2 Staff Evaluation

The applicant described its AMR of the nitrogen system for license renewal in two separate sections of its LRA, Section 2.3.3.26 and Table 3.3-34, page 3.3-210. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the nitrogen system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.26.2.1 Aging Effects

The staff reviewed the applicant's response to RAI 2.3.3.26-2, which provided AMR results for additional components (valve bodies and tubing associated with the safety-related SG PORV back-up control system) that were identified by the applicant as within the scope of license renewal (documented in Section 2.3.3.26.2 of this SER). The applicant's conclusion that no aging effects result from contact of the nitrogen SSCs to the environments listed in the RAI response and in LRA Section 2.3.3.26 and Table 3.3-34, on page 3.3-210, is consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff agrees with the applicant that there are no aging effects for the combination of materials and environments identified.

3.3.26.2.2 Aging Management Programs

There are no aging effects identified for this system. Therefore, no AMPs are required in the nitrogen system.

3.3.26.3 Conclusions

The staff reviewed the information in the applicant's response to RAI 2.3.3.26-2 and LRA Section 2.3.3.26 and Table 3.3-34, page 3.3-210. On the basis of its review, the staff concludes that the SCs in the nitrogen system are not subject to any aging effects. Therefore, no AMPs are required for the nitrogen system.

3.3.27 Nuclear Sampling System

3.3.27.1 Technical Information in the Application

The nuclear sampling system is essentially the same, and performs the same function, for McGuire and Catawba. The nuclear sampling system provides a means of obtaining samples, taken more frequently during normal plant operation, from the station's safety-related systems in a convenient, shielded, and safe environment. The system also provides a means of sampling the reactor coolant and containment atmosphere following a LOCA to monitor the reactor and determine the degree of core damage. McGuire UFSAR Section 9.3.2, "Nuclear Sampling System," provides additional information concerning the McGuire nuclear sampling system. Catawba UFSAR Section 9.3.2, "Process Sampling and Post-Accident Sampling Systems," provides additional information concerning the Catawba Nuclear Sampling System.

Components of the nuclear sampling system are described in Section 2.3.3.27 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-35, pages 3.3-211 to 3.3-213, lists individual components of the system, including orifices, pipe, tubing, and valve bodies. Stainless steel components are identified as being subject to the external environments of sheltered and reactor building with no aging effects identified. An internal environment of borated water and treated water causes the aging effect of loss of material and cracking in stainless steel components. Internal surfaces of stainless steel components exposed to gas environments are not subject to any aging effects.

The Chemistry Control Program is utilized to manage aging effects for the nuclear sampling system. The Chemistry Control Program is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common aging management program. The staff's review of this common aging management program is documented in Section 3.0 of the SER.

A description of the aging management program is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the nuclear sampling system will be adequately managed by the aging management program during the period of extended operation.

3.3.27.2 Staff Evaluation

The applicant described its AMR of the nuclear sampling system for license renewal in two separate sections of its LRA, Section 2.3.3.27 and Table 3.3-35, pages 3.3-211 to 3.3-213. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the nuclear sampling system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.27.2.1 Aging Effects

The aging effects that result from contact of the nuclear sampling SSCs to the environments described in LRA Section 2.3.3.27 and Table 3.3-35, pages 3.3-211 through 3.3-213, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.27.2.2 Aging Management Programs

LRA Section 2.3.3.27 and Table 3.3-35, pages 3.3-211 to 3.3-213, state that the Chemistry Control Program is credited for managing the aging effects in the nuclear sampling system. The Chemistry Control Program is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common aging management program. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-35, the staff concludes that the above identified AMP will effectively manage the aging effects of the nuclear sampling system, and that there is reasonable assurance that the intended functions of the nuclear sampling system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.27.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.27 and Table 3.3-35, pages 3.3-211 to 3.3-213. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the nuclear sampling system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.28 Nuclear Service Water System

3.3.28.1 Technical Information in the Application

The McGuire nuclear service water system provides cooling water from Lake Norman, or the standby nuclear service water pond, to various safety-related and non-safety-related heat exchangers. In addition, the system acts as an assured source of makeup water for various requirements, and is the normal supply of water for the containment ventilation cooling water system. McGuire UFSAR Section 9.2.2, "Nuclear Service Water System and Ultimate Heat Sink," provides additional information concerning the McGuire nuclear service water system.

The Catawba nuclear service water system, along with Lake Wylie and the standby nuclear service water pond, provides the ultimate heat sink for various safety-related heat loads during normal operation and design basis events. The nuclear service water system also supplies emergency makeup water to various safety-related systems during postulated design basis events, water for fire protection hose stations in the diesel buildings and nuclear service water pumphouse, and cooling flow and flush water for non-QA heat loads and functions during normal operation. Catawba UFSAR Section 9.2.1, "Nuclear Service Water System," provides additional information concerning the Catawba nuclear service water system.

3.3.28.1.1 Aging Effects

Components of the nuclear service water system are described in Section 2.3.3.28 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-36, pages 3.3-214 to 3.3-221 (McGuire Nuclear Station), and LRA Table 3.3-37, pages 3.3-222 to 3.3-228 (Catawba Nuclear Station), list individual components of the system, including oil coolers, expansion joints, pump casings, strainers, orifices, pipe, tubing, annubars, flexible hoses, manways, and valve bodies. Stainless steel components are identified as being subject to the external environments of sheltered, reactor building, yard, and oil with no aging effects identified. Stainless steel components identified as being subject to the external environment of underground are subject to the aging effect of loss of material and cracking. An internal environment of raw water causes the aging effect of loss of material in stainless steel components. Internal surfaces of stainless steel components exposed to oil environments are not subject to any aging effects.

Internal or external surfaces of carbon steel components exposed to raw water, reactor building, underground, yard, or sheltered environments are subject to the aging effect of loss of material. Copper-nickel components exposed to an internal environment of raw water are subject to fouling and/or loss of material. Exposure of copper-nickel components to an external oil environment has no aging effect. Brass components exposed to an internal environment of raw water are subject to loss of material. Exposure of brass components to an external environment of oil has no aging effect. Cast iron components exposed to internal or external environments of raw water or sheltered are subject to loss of material.

3.3.28.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the nuclear service water system:

- Heat Exchanger Preventive Maintenance Activities — Pump Oil Coolers
- Service Water Piping Corrosion
- Galvanic Susceptibility Inspection
- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components
- Preventive Maintenance Activities — Condenser Circulation Water System Internal Coating Inspection
- Selective Leaching Inspection

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the nuclear service water system will be adequately managed by these aging management programs during the period of extended operation.

3.3.28.2 Staff Evaluation

The applicant described its AMR of the nuclear service water system for license renewal in two separate sections of its LRA, Section 2.3.3.28 and Table 3.3-36, pages 3.3-214 to 3.3-221, and Table 3.3-37, pages 3.3-222 to 3.3-228. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the nuclear service water system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.28.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.28 and Table 3.3-36, pages 3.3-214 to 3.3-221, and Table 3.3-37, pages 3.3-222 to 3.3-228. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI-3.3.36-1, additional information pertaining to LRA Table 3.3-36, "Aging Management Review Results — Nuclear Service Water System (McGuire Nuclear Station)." This table indicates that centrifugal and reciprocating charging pumps and safety injection pump oil coolers (tubes and tubesheets) have a raw water internal/external environment with an oil internal/external environment. No aging effect is identified for these environments. Oil systems subject to water contamination are typically subject to the aging effect of loss of material. The applicant was requested to identify where in the LRA the AMR results are for the aging effect of loss of material from general, pitting, crevice, and microbiologically influenced corrosion to stainless steel and copper-nickel materials for oil coolers potentially contaminated with leaking water, or to provide a justification for excluding this aging effect from LRA Table 3.3-36 and an AMR.

In its response dated March 15, 2002, the applicant stated that all of the lube oil cooler components cited in RAI 3.3.36-1 are components of closed oil recirculation systems. Uncontaminated lube oil does not cause aging, and closed oil recirculation systems are assumed to be initially free of contaminants, such as water. Further, in the Duke aging management review, component failures were not postulated as a means to establish the relevant conditions required for aging to occur. Therefore, in oil coolers, tube failures that could introduce water into a lube oil environment are not assumed.

By electronic correspondence dated May 2, 2002 (ADAMS Accession No. ML021440217), the staff commented on the applicant's response, indicating that all systems are designed initially to be leak tight, but failures in a heat exchanger system during the lifetime of the system cannot be ruled out. In fact, industry operating experience indicates that oil periodically is contaminated with cooling water. Furthermore, leakage of water into oil systems may not involve component failures per se, but could involve minor breaches in component pressure boundaries that may go undetected and allow corrosion and other forms of degradation to progress indefinitely (which is why plants implement surveillance monitoring programs for oil lubricating and fuel oil systems). The staff further noted that the GALL report also addresses this aging effect for oil environments.

In electronic correspondence dated May 10, 2002 (ADAMS Accession No. ML021440236), the applicant responded that Duke is assuming that the staff believes breaches of the pressure boundary in the oil coolers are the result of aging of the raw water side of the cooler that allows raw water to contaminate the oil. Duke reiterates that component failures due to aging were not postulated as a means to establish the relevant conditions required for aging to occur. For the oil coolers in question, Duke identified the aging that could occur in the normal environment. No aging effects were identified for the cooler components exposed to uncontaminated oil.

The applicant further stated that aging effects were identified for the cooler components exposed to raw water that, left unmanaged, could result in a loss of the pressure boundary function. Duke credited the Heat Exchanger Preventive Maintenance Activities — Pump Oil Coolers described in Section B.3.17.7 of LRA Appendix B to maintain the pressure boundary integrity to prevent the contamination of the oil system. Industry operating experience indicates the need for such a monitoring program. Plant-specific operating experience also demonstrates that the aging management program credited has been, and will continue to be, effective during the period of extended operation. By letter from the applicant dated July 9, 2002, the staff received this information in official correspondence. The applicant was able to demonstrate that aging effects of the cooler components exposed to raw water will be adequately managed to maintain the pressure boundary integrity to prevent the contamination of the oil system. The staff agrees that uncontaminated oil will not cause any aging effect to the components, and that the applicant is not required to assume a failure that can cause an aging effect. Therefore, this issue is resolved.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.36-2, additional information pertaining to LRA Table 3.3-36, "Aging Management Review Results — Nuclear Service Water System (McGuire Nuclear Station)." This table indicates that the copper-nickel centrifugal and reciprocating charging pump, the safety injection pump bearing oil cooler, and the centrifugal charging pump speed reducer oil cooler tubes are subject to an internal environment of raw water. The applicant was requested to identify where in the LRA the AMR results are for the aging effect of selective leaching for copper-nickel components in a raw water environment, or to provide a justification for excluding this aging effect from LRA Table 3.3-36 and an AMR.

In its response dated March 15, 2002, the applicant stated that the relevant conditions required for loss of material, due to selective leaching, to occur in copper-nickel alloys are a temperature greater than 212 °F, low flow, and high local heat fluxes. These conditions are not found in the nuclear service water system. Therefore, loss of material due to selective leaching is not an aging effect requiring management during the period of extended operation for copper-nickel alloy components exposed to raw water.

In electronic correspondence dated May 2, 2002 (ADAMS Accession No. ML021440217), the staff commented on the applicant's response, stating that service water inspections and industry experience from ANO-1 indicate that, even under high flow conditions, the impurity, chlorine biocide, in the systems resulted in de-nickelification to the 90/10 copper-nickel heat exchanger tube,s where 70/30 copper-nickel may have been less susceptible to the selective leaching aging effect. The staff further noted that the copper content of the component is a significant contributor to material vulnerability, independent of temperature and flow conditions.

In electronic correspondence dated May 10, 2002 (ADAMS Accession No. ML021440236), the applicant replied that Duke believes that the industry experience from ANO-1 is not relevant to the McGuire nuclear service water system. The McGuire nuclear service water system is an untreated open-cycle cooling water system. The operating experience presented notes that selective leaching occurred as a result of the chlorine biocide. Duke does not use chlorine biocides in the McGuire nuclear service water system. Therefore, selective leaching of copper-nickel alloys is not a concern. By letter from the applicant dated July 9, 2002, the staff received this information in official correspondence. Since the applicant demonstrated that McGuire operating practices precluded selective leaching as a result of chlorine biocide, this issue is resolved.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.36-3, additional information pertaining to LRA Table 3.3-36, "Aging Management Review Results — Nuclear Service Water System (McGuire Nuclear Station)." This table indicates that the copper-nickel reciprocating charging pump bearing oil cooler and the fluid drive oil cooler tubes are subject to an internal environment of raw water. The applicant was requested to identify where in the LRA the aging effect of fouling for the copper-nickel tubes in a raw water environment was identified, or to provide a justification for excluding this aging effect from LRA Table 3.3-36 and an AMR.

In its response dated March 15, 2002, the applicant stated that the reciprocating charging pumps are not relied upon for any event at the McGuire Nuclear Station. The nuclear service water side of the reciprocating charging pump bearing oil cooler and fluid drive oil cooler is only in scope because it is associated with Class F piping and, therefore, meets the criteria of 10 CFR 54.4(a)(2). Loss of pressure boundary integrity could prevent satisfactory accomplishment of a safety function. Only the pressure boundary integrity of the reciprocating charging pump bearing oil cooler and fluid drive oil cooler is required to be maintained; heat transfer is not an intended function of the tubes that meets the scoping criteria in 10 CFR 54.4. Fouling can cause a loss of heat transfer function, but does not affect the pressure boundary function of the reciprocating charging pump bearing oil cooler and fluid drive oil cooler tubes. Therefore, fouling is not an aging effect requiring management during the period of extended operation. The staff finds this a logical explanation of why fouling is not identified as an aging effect for the copper-nickel tubes. The staff agrees with the applicant that fouling is not an applicable aging effect requiring management since heat transfer is not an intended function of the tubes that meets the scoping criteria in 10 CFR 54.4.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.36-4, additional information pertaining to LRA Table 3.3-36, "Aging Management Review Results — Nuclear Service Water System (McGuire Nuclear Station)." This table indicates that the cast iron reciprocating charging pump fluid drive oil cooler channel covers are subject to an internal environment of raw water. The applicant was requested to identify where in the LRA the aging effect of selective leaching for cast iron components in a raw water environment was identified, or to provide a justification for excluding this aging effect from LRA Table 3.3-36 and an AMR.

In its response dated March 15, 2002, the applicant stated that loss of material due to selective leaching is an aging effect applicable only to "gray" cast iron. The reciprocating charging pump fluid drive oil cooler channel covers are constructed of "long black iron," which is carbon steel. Therefore, loss of material due to selective leaching is not an aging effect requiring management during the period of extended operation for the channel covers in Table 3.3-36 of the LRA. The LRA Table 3.3-36 entry for the "Reciprocating Charging Pump Fluid Drive Oil Coolers (channel covers)" is in error. The Table 3.3-36 entry for the "Reciprocating Charging Pump Fluid Drive Oil Coolers (channel covers)" was revised to reflect the correct material for these channel covers, which is carbon steel. Since the applicant clarified that the component material is carbon steel, the staff agrees that loss of material due to selective leaching is not an applicable aging effect.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.37-1, additional information pertaining to LRA Table 3.3-37, "Aging Management Review Results — Nuclear Service Water System (Catawba Nuclear Station)." On pages 3.3-222 through 3.3-228 of the LRA, the applicant indicated that loss of material from pitting corrosion is an applicable aging effect for admiralty brass, brass, bronze, carbon steel, cast iron, copper, 90/10 copper-nickel, ductile cast iron, and stainless steel materials in a raw water environment. Pitting corrosion can be inhibited by maintaining an adequate flow rate, which prevents impurities from adhering to the material surface. The more susceptible locations for pitting corrosion to occur in materials in a raw water environment are locations of low or stagnant flow. The applicant was requested to identify where in the LRA the AMR results are for the aging effect of pitting corrosion in low flow or stagnant conditions, or to provide a justification for excluding this aging effect from LRA Table 3.3-37 and an AMR.

In its response dated March 15, 2002, the applicant stated that in the Duke aging management review, pitting corrosion is considered an aging mechanism that manifests itself as loss of material. Loss of material is the aging effect requiring management for license renewal. Loss of material is identified in LRA Table 3.3-36 for all applicable materials exposed to raw water, and is managed by the Service Water Piping Corrosion Program. The staff verified that the Service Water Piping Corrosion Program will manage loss of material. However, the applicant should justify how its program will manage the effects of localized corrosion, caused by pitting and MIC to ensure that the intended pressure boundary function is provided during all design basis events consistent with the CLB throughout the extended period of operation, as required by 10 CFR 54.21(a)(3). This issue is characterized as open item 3.0.3.15.2-1 and is discussed in detail in Section 3.0.3.15.2 of this SER.

The staff finds that the applicant's responses to RAI 3.3.36-3, 3.3.36-4, and 3.3.37-1 clarify and satisfactorily resolve these items. The aging effects that result from contact of the nuclear service water SSCs to environments as described in LRA Section 2.3.3.28 and Table 3.3-36, pages 3.3-214 to 3.3-221, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.28.2.2 Aging Management Programs

LRA Section 2.3.3.28 and Table 3.3-36, pages 3.3-214 to 3.3-221, state that the following aging management programs are credited for managing the aging effects in the nuclear service water system.

- Heat Exchanger Preventive Maintenance Activities — Pump Oil Coolers
- Service Water Piping Corrosion
- Galvanic Susceptibility Inspection
- Fluid Leak Management Program
- Inspection Program for Civil Engineering Structures and Components
- Preventive Maintenance Activities — Condenser Circulation Water System Internal Coating Inspection
- Selective Leaching Inspection

The Fluid Leak Management Program, Galvanic Susceptibility Inspection program, Service Water Piping Corrosion Program, Inspection Program for Civil Engineering Structures and Components, Preventive Maintenance Activities — Condenser Circulation Water System Internal Coating Inspection program, and Selective Leaching Inspection program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-37, the staff concludes that the above identified AMPs will effectively manage the aging effects of the nuclear service water system, and that there is reasonable assurance that the intended functions of the nuclear service water system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.28.3 Conclusions

The staff reviewed the information in Section 2.3.3.28 and Table 3.3-37 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the nuclear service water system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.29 Nuclear Service Water Pump Structure Ventilation System (Catawba Only)

3.3.29.1 Technical Information in the Application

No system corresponding to the Catawba nuclear service water pump structure ventilation system exists at McGuire. McGuire has no nuclear service water pump structure.

The Catawba nuclear service water pump structure ventilation system creates and maintains a suitable environmental temperature for the operation of equipment located in the nuclear service water pump structure. Catawba UFSAR Section 9.4.8, "Nuclear Service Water Pump Structure Ventilation System," provides additional information concerning the Catawba nuclear service water pump structure ventilation system.

3.3.29.1.1 Aging Effects

Components of the nuclear service water pump structure ventilation system are described in Section 2.3.3.29 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-38, pages 3.3-229 to 3.3-230, lists individual components of the system, including ductwork, pipe, tubing, and valve bodies. Galvanized steel, brass, copper, or stainless steel components exposed to ventilation and sheltered environments are not subject to any aging effects. Carbon steel components exposed to sheltered environments demonstrate loss of material. Exposure of carbon steel to an internal environment of ventilation has no aging effect.

3.3.29.1.2 Aging Management Programs

The Inspection Program for Civil Engineering Structures and Components is utilized to manage aging effects for the nuclear service water pump structure ventilation system. A description of the aging management program is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the nuclear service water pump structure ventilation system will be adequately managed by the aging management program during the period of extended operation.

3.3.29.2 Staff Evaluation

The applicant described its AMR of the nuclear service water pump structure ventilation system for license renewal in two separate sections of its LRA, Section 2.3.3.29 and Table 3.3-38, pages 3.3-229 to 3.3-230. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the nuclear service water pump structure ventilation system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.29.2.1 Aging Effects

The aging effects that result from contact of the nuclear service water pump structure ventilation SSCs to the environments described in LRA Section 2.3.3.29 and Table 3.3-38, pages 3.3-229 through 3.3-230, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.29.2.2 Aging Management Programs

LRA Section 2.3.3.29 and Table 3.3-38, pages 3.3-229 to 3.3-230, state that the Inspection Program for Civil Engineering Structures and Components is credited for managing the aging effects in the nuclear service water pump structure ventilation system. The Inspection Program for Civil Engineering Structures and Components is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common aging management program. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-38, the staff concludes that the above identified AMP will effectively manage the aging effects of the nuclear service water pump structure ventilation system, and that there is reasonable assurance that the intended functions of the nuclear service water pump structure ventilation system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.29.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.29 and Table 3.3-38, pages 3.3-229 to 3.3-230. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the nuclear service water pump structure ventilation system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.30 Nuclear Solid Waste Disposal System

3.3.30.1 Technical Information in the Application

The McGuire nuclear solid waste disposal system is relied upon to contain solid radioactive waste materials as they are produced in the station. McGuire UFSAR Section 11.5, "Nuclear Solid Waste Disposal System," provides additional information concerning the McGuire nuclear solid waste disposal system.

The Catawba solid radwaste system provides capacity to contain and store radioactive waste materials as they are produced in the station, and prepares the waste for eventual shipment to a licensed offsite disposal facility. The solid radwaste system is a non-safety-related system whose postulated failure could prevent satisfactory accomplishment of certain safety-related functions. To preclude these postulated failures, portions of this system are seismically designed (i.e., Duke Class F). All components within the seismically designed piping boundaries of this system are within the scope of license renewal per 10 CFR 54.4(a)(2).

3.3.30.1.1 Aging Effects

Components of the nuclear solid waste disposal system are described in Section 2.3.3.30 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-39, pages 3.3-231 to 3.3-233, lists individual components of the system, including screens, resin storage tanks, pipe, tubing, and valve bodies. Stainless steel components are identified as being subject to the external environments of sheltered and gas with no aging effects identified. Internal or external environments of treated water cause the aging effects of loss of material and cracking in stainless steel components. Internal surfaces of stainless steel components exposed to gas environments are not subject to any aging effects.

3.3.30.1.2 Aging Management Programs

The Treated Water Systems Stainless Steel Inspection is utilized to manage aging effects for the nuclear solid waste disposal system. A description of the aging management program is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the solid waste disposal system will be adequately managed by the aging management program during the period of extended operation.

3.3.30.2 Staff Evaluation

The applicant described its AMR of the nuclear solid waste disposal system for license renewal in two separate sections of its LRA, Section 2.3.3.30 and Table 3.3-39, pages 3.3-231 to 3.3-233. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the nuclear solid waste disposal system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.30.2.1 Aging Effects

The aging effects that result from contact of the nuclear solid waste disposal SSCs to the environments described in LRA Section 2.3.3.30 and Table 3.3-39, pages 3.3-231 through 3.3-233, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.30.2.2 Aging Management Programs

LRA Section 2.3.3.30 and Table 3.3-39, pages 3.3-231 to 3.3-233, state that the Treated Water Systems Stainless Steel Inspection is credited for managing the aging effects in the nuclear solid waste disposal system. The Treated Water Systems Stainless Steel Inspection Program is credited with managing the aging effects of several components in different structures and systems and is, therefore, considered a common aging management program. The staff has evaluated this common AMP and found it to be acceptable for managing the aging effects identified for this system. The staff's evaluation of this AMP is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-39, the staff concludes that the above identified AMP will effectively manage the aging effects of the nuclear solid waste disposal system, and that there is reasonable assurance that the intended functions of the nuclear solid waste disposal system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.30.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.30 and Table 3.3-39, pages 3.3-231 to 3.3-233. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the nuclear solid waste disposal system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.31 Reactor Coolant Pump Motor Oil Collection Subsystem

3.3.31.1 Technical Information in the Application

Each reactor coolant pump motor at McGuire and Catawba is equipped with an oil collection system that contains any oil leakage.

3.3.31.1.1 Aging Effects

Components of the reactor coolant pump motor oil collection subsystem are described in Section 2.3.3.31 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-40, pages 3.3-234 to 3.3-238, lists individual components of the system, including flexible hoses, level gauges, drain tanks, pump casings, oil catchers, oil pots, oil lift enclosures, pipe, and valve bodies. Exposure of internal and external surfaces of stainless steel to ventilation, reactor building, and sheltered environments has no aging effect. Exposure of carbon steel to reactor building and sheltered external environments results in loss of material. Exposure of internal surfaces of carbon steel components to ventilation environments has no aging effect. Cast iron components exposed to external reactor building environment demonstrate loss of material. Cast iron exposed to a ventilation environment has no aging effect. Glass components exposed to ventilation and reactor building environments are not subject to any aging effects.

3.3.31.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the reactor coolant pump motor oil collection subsystem:

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the reactor coolant pump motor oil collection subsystem will be adequately managed by these aging management programs during the period of extended operation.

3.3.31.2 Staff Evaluation

The applicant described its AMR of the reactor coolant pump motor oil collection subsystem for license renewal in two separate sections of its LRA, Section 2.3.3.31 and Table 3.3-40, pages 3.3-234 to 3.3-238. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the reactor coolant pump motor oil collection subsystem will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.31.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.31 and Table 3.3-40, pages 3.3-234 to 3.3-238. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3.40-1, additional information pertaining to LRA Table 3.3-40, "Aging Management Review Results — Reactor Coolant Pump Motor Oil Collection Subsystem." This table indicates that flexible hoses are of the material type of stainless steel. Per CN-1553-1.3 and CN-2553.1-3, "Flow Diagram of Reactor Coolant System (NC)," line listings for the flexible hoses between the upper bearing oil enclosures and the reactor coolant pump motor drain tank are carbon steel. The applicant was requested to identify where in the LRA the AMR results are for the reactor coolant pump motor oil collection subsystem carbon steel flexible hoses, or to provide a justification for excluding these components from LRA Table 3.3-40 and an AMR.

In its response dated March 15, 2002, the applicant stated that in general, the materials identified in the line listings on Duke flow diagrams refer to pipe and pipe components and would be generally used for other system components. Materials for some engineered components may be different than the general system material, as is the case here. All of the flexible hoses shown on flow diagrams CN-1553-1.3 and CN-2553-1.3 are stainless steel. No carbon steel flexible hoses are installed within the license renewal evaluation boundaries of the reactor coolant pump motor oil collection subsystem. Since the applicant clarified that the components are made of stainless steel, the staff finds its response acceptable.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.40-2, additional information pertaining to LRA Table 3.3-40, "Aging Management Review Results — Reactor Coolant Pump Motor Oil Collection Subsystem." This table indicates that all components are subject to an internal environment of ventilation, and an external environment of reactor building or ventilation. The applicant was requested to explain why these components of the reactor coolant pump motor oil collection subsystem are not subject to an internal and/or external environment of oil.

In its response dated March 15, 2002, the applicant stated that, in accordance with plant directives and procedures, the reactor coolant pump motor oil collection subsystem is not allowed to be used as an oil storage system. Any used oil that has collected in the drain tank during operation is drained from the system during each refueling outage, and the system is flushed before returning to service following the outage. Therefore, the internal environment of the system at the beginning of each operating cycle is air that enters the system from the reactor building environment during the fill, drain, and flush operations, and oil leakage is not expected as a normal operating condition. Since the collected oil will be drained from the system during each outage, and the system is flushed before it is returned to service, the staff agrees that the applicant is not required to assume contamination of the internal environment with oil leakage.

The staff finds that the applicant's responses clarify and satisfactorily resolve these items. The aging effects that result from contact of the reactor coolant pump motor oil collection subsystem SSCs to the environments described in LRA Section 2.3.3.31 and Table 3.3-40, pages 3.3-234 through 3.3-238, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.31.2.2 Aging Management Programs

LRA Section 2.3.3.31 and Table 3.3-40, pages 3.3-234 to 3.3-238, state that the following aging management programs are credited for managing the aging effects in the reactor coolant pump motor oil collection subsystem.

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program

The Fluid Leak Management Program and the Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-40, the staff concludes that the above identified AMPs will effectively manage the aging effects of the reactor coolant pump motor oil collection subsystem, and that there is reasonable assurance that the intended functions of the reactor coolant pump motor oil collection subsystem will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.31.3 Conclusions

The staff reviewed the information in Section 2.3.3.31 and Table 3.3-40 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the reactor coolant pump motor oil collection subsystem will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.32 Reactor Coolant System (Non-Class 1 Components)

3.3.32.1 Technical Information in the Application

The non-class 1 portions of the RCS (excluding the RCP motor oil collection subsystem) are essentially the same, and perform the same function, for McGuire and Catawba. The non-class 1 portions of the RCS are relied upon to provide and maintain containment isolation and closure, and to maintain system pressure boundary integrity. The reactor vessel leak-off line is included within this set of components, and is relied upon only in the event the reactor vessel flange inner seal leaks.

3.3.32.1.1 Aging Effects

Components of the RCS (non-Class 1 components) are described in Section 2.3.3.32 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-41, pages 3.3-239 to 3.3-241, lists individual components of the system, including orifices, pipe, tubing, and valve bodies. Stainless steel components are identified as being subject to the internal or external environments of reactor building, sheltered, and gas with no aging effects identified. Stainless steel components exposed to borated water environments demonstrate loss of material and cracking. Carbon steel components are subject to the aging effect of loss of material from external surfaces exposed to sheltered environments. Carbon steel components are identified as being subject to the internal environment of gas with no aging effects identified.

3.3.32.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the RCS (non-Class 1 components):

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program
- Chemistry Control Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the RCS (non-Class 1 components) will be adequately managed by these aging management programs during the period of extended operation.

3.3.32.2 Staff Evaluation

The applicant described its AMR of the RCS (non-Class 1 components) for license renewal in two separate sections of its LRA, Section 2.3.3.32 and Table 3.3-41, pages 3.3-239 to 3.3-241. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the RCS (non-Class 1 components) will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.32.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.32 and Table 3.3-41, pages 3.3-239 to 3.3-241. During its review, the staff determined that additional information was needed to complete its review. By letter dated in January 23, 2002, the staff requested, in RAI 3.3.41-1, additional information pertaining to LRA Table 3.3-41, "Aging Management Review Results — Reactor Coolant System (non-Class 1 Components)." This table refers to Note (3), which states that orifices may be subjected to a borated water or steam environment. The applicant was requested to identify where in the LRA the AMR results are for the RCS orifices in a borated water or steam environment, or to provide a justification for excluding these environments from LRA Table 3.3-41 and an AMR.

In its response dated March 15, 2002, the applicant stated that the orifice listed in Table 3.3-41 of the LRA is located in the common reactor vessel high-point vent line, downstream from the parallel, redundant vent line isolation valve sets, which are isolated during normal plant operation. These orifices are depicted on drawings MCFD 1553-2.01 (at K-6), MCFD-2553-2.01 (at K-6), CN-1553-1.1 (at K-7), and CN-2553-1.1 (at K-7). The vent line is normally used only during system fill operations to vent gasses from the RCS to the pressurizer relief tank, or during an accident to ensure that voiding does not occur in the reactor vessel head. The orifice and downstream piping between the orifice and the pressurizer relief tank are open to the pressurizer relief tank environment. As a result, the orifice is exposed to the gas environment normal to the pressurizer relief tank. Therefore, the aging management review was performed for a "gas" environment. Note (3) should not have been included at the end of LRA Table 3.3-41. Since the orifice listed in Table 3.3-41 of the LRA is only subject to a gas environment, and the applicant has corrected the error in Note (3), the staff finds that the applicant's response clarifies and satisfactorily resolves this item.

The aging effects that result from contact of the RCS (non-Class 1 components) SSCs to the environments described in LRA Section 2.3.3.32 and Table 3.3-41, pages 3.3-239 through 3.3-241, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.32.2.2 Aging Management Programs

LRA Section 2.3.3.32 and Table 3.3-41, pages 3.3-239 to 3.3-241, state that the following aging management programs are credited for managing the aging effects in the RCS (non-Class 1 components).

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program
- Chemistry Control Program

The Fluid Leak Management Program, Chemistry Control Program, and Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-41, the staff concludes that the above identified AMPs will effectively manage the aging effects of the RCS (non-Class 1 components), and that there is reasonable assurance that the intended functions of the RCS (non-Class 1 components) will remain consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.32.3 Conclusions

The staff reviewed the information in Section 2.3.3.32 and Table 3.3-41 of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the RCS (non-Class 1 components) will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.33 Recirculated Cooling Water System (Catawba Nuclear Station Only)

3.3.33.1 Technical Information in the Application

No portion of the McGuire recirculated cooling water system is within the scope of license renewal. Only the Duke Class F portions of the recirculated cooling water system are in scope at Catawba. McGuire has no Class F components in the recirculated cooling water system.

The Catawba recirculated cooling water system is a closed cooling system that delivers clean, rust-inhibited cooling water of a regulated temperature to various equipment in the turbine buildings, auxiliary building, and service building. The recirculated cooling water system is a non-safety-related system whose postulated failure could prevent satisfactory accomplishment of certain safety-related functions. To preclude these postulated failures, portions of this system are seismically designed (i.e., Duke Class F). All components within the seismically designed piping boundaries of this system are within the scope of license renewal per 10 CFR 54.4(a)(2).

3.3.33.1.1 Aging Effects

Components of the recirculated cooling water system are described in Section 2.3.3.33 of the LRA as being within the scope of license renewal, and subject to an AMR. Table 3.3-42, page 3.3-242, of the LRA lists individual components of the system, including pipe and valve bodies. Carbon steel components are subject to the aging effect of loss of material from external surfaces exposed to the sheltered environments. Carbon steel components are identified as being subject to loss of material and cracking from exposure to the internal environment of treated water.

3.3.33.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the recirculated cooling water system:

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program
- Chemistry Control Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the recirculated cooling water system will be adequately managed by these aging management programs during the period of extended operation.

3.3.33.2 Staff Evaluation

The applicant described its AMR of the recirculated cooling water system for license renewal in two separate sections of its LRA, Section 2.3.3.33 and Table 3.3-42, page 3.3-242. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the recirculated cooling water system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.33.2.1 Aging Effects

The aging effects that result from contact of the recirculated cooling water SSCs to the environments described in Section 2.3.3.33 and Table 3.3-42, page 3.3-242, of the LRA are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.33.2.2 Aging Management Programs

Section 2.3.3.33 and Table 3.3-42, page 3.3-242, of the LRA state that the following aging management programs are credited for managing the aging effects in the recirculated cooling water system.

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program
- Chemistry Control Program

The Fluid Leak Management Program, Chemistry Control Program, and Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-42, the staff concludes that the above identified AMPs will effectively manage the aging effects of the recirculated cooling water system, and that there is reasonable assurance that the intended functions of the recirculated cooling water system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.33.3 Conclusions

The staff reviewed the information in Section 2.3.3.33 and Table 3.3-42, page 3.3-242, of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the recirculated cooling water system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.34 Spent Fuel Cooling System

3.3.34.1 Technical Information in the Application

The McGuire spent fuel cooling system removes heat from the spent fuel pool and maintains the purity and optical clarity of the pool water for fuel handling operations. The purification loop provides an alternate means for removing impurities from either the refueling canal/transfer canal water during refueling, or the refueling water storage tank water following refueling. The fuel pool water also serves as a source of makeup water to the RCS during a standby shutdown system event. McGuire UFSAR Section 9.1.3, "Spent Fuel Cooling and Purification," provides additional information concerning the McGuire spent fuel cooling system.

The Catawba spent fuel cooling system, in conjunction with the component cooling water system and nuclear service water system, is designed to remove heat from the spent fuel pool and maintain purity and optical clarity of the pool water during fuel handling operations. The purification loop provides an alternate means for removing impurities from either the refueling cavity/transfer canal water during refueling, or the refueling water storage tank water following refueling. Catawba UFSAR Section 9.1.3, "Spent Fuel Cooling and Purification," provides additional information concerning the Catawba spent fuel cooling system.

3.3.34.1.1 Aging Effects

Components of the spent fuel cooling system are described in Section 2.3.3.34 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-43, pages 3.3-243 to 3.3-246, lists individual components of the system, including heat exchangers (channel heads, shells, tubes, and tubesheets), orifices, pump casings, spacers, pipe, tubing, and valve bodies. Stainless steel components are identified as being subject to the external environments of sheltered and reactor building with no aging effects identified. An internal or external environment of borated water or treated water causes the aging effects of loss of material and cracking in stainless steel components. Carbon steel components are subject to the aging effect of loss of material and cracking from exposure to internal and external surfaces from treated water environments. Carbon steel components are identified as being subject to loss of material from sheltered environments.

3.3.34.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the spent fuel cooling system:

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program
- Chemistry Control Program

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the spent fuel cooling system will be adequately managed by these aging management programs during the period of extended operation.

3.3.34.2 Staff Evaluation

The applicant described its AMR of the spent fuel cooling system for license renewal in two separate sections of its LRA, Section 2.3.3.34 and Table 3.3-43, pages 3.3-243 to 3.3-246. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the spent fuel cooling system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.34.2.1 Aging Effects

The aging effects that result from contact of the spent fuel cooling SSCs to the environments described in LRA Section 2.3.3.34 and Table 3.3-43, pages 3.3-243 through 3.3-246, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.34.2.2 Aging Management Programs

LRA Section 2.3.3.34 and Table 3.3-43, pages 3.3-243 to 3.3-246, state that the following aging management programs are credited for managing the aging effects in the spent fuel cooling system.

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program
- Chemistry Control Program

The Fluid Leak Management Program, Chemistry Control Program, and Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-43, the staff concludes that the above identified AMPs will effectively manage the aging effects of the spent fuel cooling system, and that there is reasonable assurance that the intended functions of the spent fuel cooling system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.34.3 Conclusions

The staff reviewed the information in LRA Section 2.3.3.34 and Table 3.3-43, pages 3.3-243 to 3.3-246. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the spent fuel cooling system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.35 Standby Shutdown Diesel

3.3.35.1 Technical Information in the Application

The standby shutdown diesel system is essentially the same, and performs the same function, for McGuire and Catawba. The standby shutdown diesel system provides an alternate and independent means of achieving and maintaining a hot standby condition for one or both units following a postulated fire event. The diesel provides power to the standby shutdown facility required components, instrumentation, and controls for a period of up to 72 hours.

3.3.35.1.1 Aging Effects

Components of the standby shutdown diesel system are described in Section 2.3.3.35 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-44, pages 3.3-247 to 3.3-255, lists individual components of the system, including cooling water filters, heat exchanger engine radiators, tubing, valve bodies, exhaust bellows, piping, silencers, duplex filters, flame arrestors, level glass, pipe, oil storage tanks, tank vents, pump casings, and oil filters. Stainless steel components exposed to internal environments of ventilation, yard, or sheltered exhibit no aging effects. Stainless steel components exposed to internal or external environments of fuel oil are subject to the loss of material aging effect. Stainless steel components exposed to an underground environment are subject to the aging effects of cracking and loss of material.

Internal surfaces of carbon steel components exposed to treated water are subject to cracking and loss of material. Carbon steel exposed to sheltered, yard, underground, or fuel oil internal or external environments exhibit the aging effect of loss of material. Carbon steel components exposed to ventilation or oil environments have no aging effects identified. Copper components exposed to an internal environment of treated water are subject to loss of material. Copper components exposed to ventilation or sheltered environments have no aging effects identified.

Brass components exposed to an internal environment of treated water are subject to loss of material and cracking. Exposure of brass components to a sheltered environment is not subject to any aging effects. Cast iron components exposed to internal or external environments of treated water or sheltered are subject to that aging effects of loss of material. Aluminum exposed to ventilation or sheltered environments have no aging effect identified.

Bronze components exposed to fuel oil environments demonstrate the aging effect of loss of material, while exposure of bronze to the sheltered environment has no aging effect identified. Wrought iron components exposed to internal or external environments of fuel oil or sheltered environments are subject to the aging effect of loss of material. Glass or acrylic components exposed to fuel oil, ventilation, or sheltered environments exhibit no aging effects.

3.3.35.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the standby shutdown diesel system:

- Inspection Program for Civil Engineering Structures and Components
- Chemistry Control Program
- Preventive Maintenance Activities — Condenser Circulating Water System Internal Coatings Inspection

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the standby shutdown diesel system will be adequately managed by these aging management programs during the period of extended operation.

3.3.35.2 Staff Evaluation

The applicant described its AMR of the standby shutdown diesel system for license renewal in two separate sections of its LRA, Section 2.3.3.35 and Table 3.3-44, pages 3.3-247 to 3.3-255. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the standby shutdown diesel system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.35.2.1 Aging Effects

The staff reviewed the information in LRA Section 2.3.3.35 and Table 3.3-44, pages 3.3-247 to 3.3-255. During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3-5, additional information pertaining to LRA Table 3.3-44, "Aging Management Review Results — Standby Shutdown Diesel Generator, Exhaust Subsystem." This table indicated that components are subject to an internal environment of ventilation, which is defined as ambient air that is conditioned to maintain a suitable environment for equipment operation and personnel occupancy. CN-1560-1.0, CN-1560-20, MCFD-1560-01.00, MCFD-1560-02.00, and MCFD-1614-4, "Flow Diagrams for Standby Shutdown Diesel System," do not include equipment to condition the intake air or the exhaust air for the diesels to provide a ventilation internal environment. Typically, these components are subject to a sheltered internal environment. The applicant was requested to provide justification for classifying the internal environment for these components as "ventilation." A similar question was asked about the diesel generator air intake and exhaust system components listed in LRA Table 3.3-14 (refer to Section 3.3.11.2.1 of this SER).

In its response dated, March 15, 2002, the applicant stated that the staff is correct that these components are subject to a sheltered internal environment. Duke's aging management review conservatively evaluated environments, such as tanks and piping that are open to atmosphere, as a ventilation environment. Although the tanks and piping are open to sheltered environments, they would not experience significant air exchange, and thus higher humidity and condensation could be present. The ventilation environment aging effect details account for the potential condensation, whereas the sheltered environment aging effect details do not. Loss of material and cracking due to alternate wetting and drying that concentrates contaminants are two aging effects considered plausible in a ventilation environment, but are not considered in sheltered environments. Loss of material due to selective leaching is another aging effect considered plausible in a ventilation environment, but is not considered in sheltered environments. Therefore, for conservatism, Duke chose to evaluate these component configurations using the ventilation environment aging management review details. The designation in the LRA table reflects this decision.

In electronic correspondence dated May 2, 2002 (ADAMS Accession No. ML021440217), the staff requested the applicant to provide additional justification for claiming, in LRA Table 3.3-44, that carbon steel external components are subject to sheltered environments, while the internal environment is ventilation. The sheltered environment is subject to the aging effect of loss of material and managed by the "Inspection Program for Civil Engineering Structures and Components." The staff considered this to be in conflict with Duke's response that loss of material in sheltered environments is not considered an aging effect. The applicant was requested to clarify or justify how an "uncontrolled" sheltered environment is less conservative than a "controlled" ventilation environment, and causes no aging effects, or to revise the aging effects and AMPs listed in LRA Table 3.3-44 to be consistent with other sheltered environments listed in the tables. The staff further noted that its fundamental concern was that, for the diesel engine exhaust systems (which include no equipment (coolers or dryers) for controlling air quality), the internal environments are "sheltered," not "ventilation," and that the aging effects associated with the sheltered environment must be addressed for these internal surfaces.

In electronic correspondence dated May 10, 2002 (ADAMS Accession No. ML021440236), the applicant replied as follows:

> For Duke, a sheltered environment is an external environment for components inside a structure that may or may not be maintained by a ventilation system but are protected from the natural elements. Components in a sheltered environment could be wet from condensation or leakage that could promote aggressive corrosion, that left unmanaged, could result in a loss of the component intended function(s) during the period of extended operation. As such, the Inspection Program for Civil Engineering Structures and Components is credited to manage the aging effects on the external surfaces of components located in a sheltered environment.
>
> For components with an internal air environment open to the sheltered environment or yard environment (as is the case with the diesel exhaust), Duke classified the environment as a ventilation environment. Duke conservatively chose the ventilation environment because more aging mechanisms leading to aging effects are plausible and must be considered than in a sheltered environment. In our initial response to RAI 3.3-5, Duke tried to show that aging effects from some mechanisms are not plausible in a sheltered environment but could occur in a ventilation environment. Duke was providing examples to support our conservative position which we believe does not say that loss of material in a sheltered environment is not an aging effect.
>
> Duke evaluated the internal environment of the exhaust systems as a ventilation environment. The diesels operate periodically for short periods of time for testing but are primarily in standby. The

> internal environment is characterized as a warm, dry environment free from leaks and condensation. This environment does not preclude loss of material but does not promote the aggressive corrosion that left unmanaged would result in a loss of the component intended function(s) of the exhaust system components. Therefore, no aging effects requiring management during the period of extended operation were identified.

By letter dated July 9, 2002, the staff received this information from the applicant in official correspondence. The applicant confirmed that the internal environment is warm, dry, and free from leaks and condensation. Since this environment does not promote the aggressive corrosion that would result in a loss of the component intended function(s) of the exhaust system components, this issue is resolved.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.44-1, additional information pertaining to LRA Table 3.3-44, "Aging Management Review Results — Standby Shutdown Diesel Generator, Exhaust Subsystem." This table does not list an internal environment, which has the potential for exposure of components to hot diesel engine exhaust gasses containing moisture and particulates. The applicant was requested to identify where in the LRA the AMR results are for steel components exposed to a hot diesel exhaust environment that have the potential for experiencing loss of material from general, pitting, and crevice corrosion, or to provide a justification for excluding this environment and aging effects from LRA Table 3.3-44 and an AMR.

In its response dated March 15, 2002, the applicant stated that the results of the aging management review for the internal surfaces of the standby shutdown diesel generator, exhaust subsystem are presented in Table 3.3-44 of the LRA. The diesel generators are normally in standby and are operated periodically for a short period of time for surveillance testing. During diesel operation, the exhaust portion of this system will be exposed to hot gasses containing moisture and particulates. Exposure duration of the exhaust components to the hot gasses containing moisture and particulates is insignificant when compared to the exposure time of these components to the cool, ventilation environment. As a result, the internal environment of hot gasses containing moisture and particulates was not considered in the aging management review to identify the aging effects requiring management. Therefore, LRA Table 3.3-44 listed ventilation as the internal environment. Since the components are used only during startup of the diesel generator, the staff agrees that ventilation is the normal internal environment.

By letter dated January 23, 2002, the staff requested, in RAI 3.3.44-2, additional information pertaining to LRA Table 3.3-44, "Aging Management Review Results — Standby Shutdown Diesel Generator, Fuel Oil Subsystem." This table indicates that the shutdown diesel generator fuel oil valve bodies, fuel oil (duplex filters, Catawba only, on page 3.3-254 of the LRA) has a "PB," or pressure boundary, component function. This component also provides filtration of process fluids, so that downstream equipment and/or environments are protected. The applicant was requested to explain why this component does not have a "FI," or filtration, component function, as defined in the notes section for other AMR tables, or to correct the component functions for filters listed in LRA Table 3.3-44.

In its response dated March 15, 2002, the applicant stated that the LRA Table 3.3-44 entry "Valve Bodies, Fuel Oil (duplex filters) (Catawba only)" pertains to the valves associated with the duplex filter assembly, not the filter itself. Although not necessary, the valves were differentiated because they were the only valves in the system with the given material/environment combination. The duplex filter is addressed in the entry on page 3.3-249, "Filter, Duplex (mounting head)," of the LRA. The mounting head is the only passive, long-lived portion of the duplex filter. The staff's evaluation of the applicant's treatment of filters is documented in Section 2.1.3.2.1 of this SER. Since the applicant clarified that the PB function is provided by valves associated with the duplex filter assembly, and that the filter is not subject to an AMR since it is replaced during periodic diesel engine maintenance, the staff finds that its response is acceptable. The applicant addressed filters on page 2.1.2.1.2 of the LRA; the staff's evaluation of the applicant's treatment of filters is provided in Section 2.1.3.2.1 of this SER.

In its April 15, 2002, response to RAI 2.3.3.35-5 (see Section 2.3.3.35.2 of this SER), the applicant provided the following AMR results for carbon steel pipe (tubing) and pump casings to supplement the information provided in LRA Table 3.3-44:

Component Type	Component Function	Material	Internal Environment / External Environment	Aging Effects	Aging Management Programs and Activity
Pipe	PB	CS	Treated Water	Cracking (Note 3)	Chemistry Control Program
				Loss of Material	Chemistry Control Program
			Sheltered	Loss of Material	Inspection Program for Civil Engineering Structures and Components
Pump Casing (cooling water)	PB	CS	Treated Water	Cracking (Note 3)	Chemistry Control Program
				Loss of Material	Chemistry Control Program
			Sheltered	Loss of Material	Inspection Program for Civil Engineering Structures and Components

The aging effects that result from contact of the standby shutdown diesel SSCs to the environments described in the applicant's response to RAI 2.3.3.35-5, and LRA Section 2.3.3.35 and Table 3.3-44, pages 3.3-247 through 3.3-255, are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.35.2.2 Aging Management Programs

LRA Section 2.3.3.35 and Table 3.3-44, pages 3.3-247 to 3.3-255, state that the following aging management programs are credited for managing the aging effects in the standby shutdown diesel system.

- Inspection Program for Civil Engineering Structures and Components
- Chemistry Control Program
- Preventive Maintenance Activities — Condenser Circulating Water System Internal Coatings Inspection

The Preventive Maintenance Activities — Condenser Circulating Water System Internal Coatings Inspection Program, Chemistry Control Program, and Inspection Program for Civil Engineering Structures and Components are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

The staff reviewed the information in LRA Section 2.3.3.35; Table 3.3-44, pages 3.3-247 to 3.3-255; and Section B.3.6, "Chemistry Control Program." During its review, the staff determined that additional information was needed to complete its review. By letter dated January 23, 2002, the staff requested, in RAI 3.3-6, additional information pertaining to LRA Table 3.3-44, "Aging Management Review Results — Standby Shutdown Diesel Generator." This table indicates that the cooling water and jacket water engine radiator heat exchanger has a function of HT that is managed by the Chemistry Control Program. Heat transfer monitoring is not identified as a capability of the Chemistry Control Program, as defined in Appendix B, Section B.3.6, of the LRA. The applicant was requested to explain how the Chemistry Control Program monitors the heat transfer function.

In its response dated March 15, 2002, the applicant stated that for the heat exchangers in the standby shutdown diesel generator, cooling water and jacket water heating subsystem, Duke determined that the component intended functions that must be maintained for the period of extended operation for these heat exchangers are heat transfer and pressure boundary. For heat exchangers, fouling is the only aging effect that will result in a loss of the intended function of heat transfer. Duke determined during the aging management review that fouling would not occur for these closed loop heat exchangers because there is constant flow through the heat exchangers, and the treated water in the system is filtered to remove particles. Therefore, no aging management program is required. Loss of material is an aging effect that could result in a loss of the intended function of pressure boundary for these heat exchangers during the period of extended operation. The Chemistry Control Program is credited as the aging management program to manage loss of material during the period of extended operation.

The staff agreed that the Chemistry Control Program will manage the loss of material because it provides for chemistry controls and the presence of corrosion inhibitors in the treated water to which the heat exchanger is exposed. However, the staff did not agree with the applicant's conclusion that fouling will not occur in the heat exchanger because of constant flow through the heat exchanger. The staff recognized that sufficient flow through the heat exchanger may prevent areas of stagnation in which fouling may occur. However, the applicant had not substantiated its conclusion with any operating experience, such as maintenance and surveillance results, to indicate that this activity had been successful in preventing fouling. With respect to the filtering of the treated water to remove particles, the staff recognized that particulates are removed through a filtering process. However, the applicant did not list or credit a periodic surveillance of the filter to ensure that the entrained particles did not create a high differential pressure and adversely affect flow through the heat exchanger. Therefore, this issue was characterized as SER open item 3.3.35.2-1.

In its response dated October 28, 2002, the applicant stated that fouling due to silting will be identified as an aging effect requiring management for the heat exchanger in the standby shutdown diesel cooling water and jacket water heating subsystem. The applicant further clarified that the standby shutdown diesel cooling water and jacket water heating subsystems are closed cooling water systems treated with corrosion inhibitors. These corrosion inhibitors preclude the formation of corrosion products, and the inhibitor concentration is maintained by the Chemistry Control Program. In addition, the second entry in Table 3.3-44, "Aging Management Results — Standby Shutdown Diesel," on page 3.3-247 of the LRA will be replaced with the following:

Component Type	Component Function	Material	Internal Environment / External Environment	Aging Effects	Aging Management Programs and Activities
Heat Exchanger Engine Radiator (tubes)	PB, HT	Cu	Treated Water	Loss of Material Fouling	Chemistry Control Program
			Ventilation	None Identified	None Required

The staff finds that the clarifications and changes provided by the applicant are appropriate to ensure that the aging effects associated with the heat exchanger in the standby shutdown diesel cooling water and jacket water heating subsystem will be adequately managed during the period of extended operation. The identification of fouling as an aging effect, and its management through corrosion inhibitors monitored by the Chemistry Control Program, are acceptable because the program precludes the formation of corrosion products that can cause the fouling of the heat exchanger and adversely impact the heat transfer function. Therefore, open item 3.3.35.2-1 is closed.

Based on its review of LRA Table 3.3-44, and with the resolution of open item 3.3.35.2-1, the staff concludes that the above identified AMPs will effectively manage the aging effects of the standby shutdown diesel system, and that there is reasonable assurance that the intended functions of the standby shutdown diesel system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.35.3 Conclusions

The staff reviewed the information in the applicant's response to RAI 2.3.3.35-5, and LRA Section 2.3.3.35 and Table 3.3-44. On the basis of its review, and with the resolution of open item 3.3.35.2-1, the staff concludes that the applicant has demonstrated that the aging effects associated with the standby shutdown diesel system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.36 Turbine Building Sump Pump System (Catawba Nuclear Station Only)

3.3.36.1 Technical Information in the Application

No portion of the McGuire turbine building sump pump system is within the scope of license renewal. Only the Duke Class F portions of the turbine building sump pump system are in scope at Catawba. McGuire has no Class F components in the turbine building sump pump system.

The Catawba turbine building sump pump system serves as a collection point for the contents of liquid radwaste system sumps when the contents of the sumps contain less than predetermined levels of radiation, as sensed by radiation monitors in the discharge lines. The turbine building sump pump system is a non-safety-related system whose postulated failure could prevent satisfactory accomplishment of certain safety-related functions. To preclude these postulated failures, portions of this system are seismically designed (i.e., Duke Class F). All components within the seismically designed piping boundaries of this systems are within the scope of license renewal per 10 CFR 54.4(a)(2).

3.3.36.1.1 Aging Effects

Components of the turbine building sump pump system are described in Section 2.3.3.36 of the LRA as being within the scope of license renewal, and subject to an AMR. LRA Table 3.3-45, page 3.3-256, of the LRA lists individual components of the system, including pipe. Carbon steel components exposed to a raw water internal environment and a sheltered external environment are subject to loss of material aging effects.

3.3.36.1.2 Aging Management Programs

The following AMPs are utilized to manage aging effects for the turbine building sump pump system:

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program
- Sump Pump Systems Inspection

A description of these aging management programs is provided in Appendix B of the LRA. The applicant concludes that the effects of aging associated with the components of the turbine building sump pump system will be adequately managed by these aging management programs during the period of extended operation.

3.3.36.2 Staff Evaluation

The applicant described its AMR of the turbine building sump pump system for license renewal in two separate sections of its LRA, Section 2.3.3.36 and Table 3.3-45, page 3.3-256. The staff reviewed these sections of the LRA to determine whether the applicant had demonstrated that the effects of aging for the turbine building sump pump system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.36.2.1 Aging Effects

The aging effects that result from contact of the turbine building sump pump SSCs to the environments described in Section 2.3.3.36 and Table 3.3-45, page 3.3-256, of the LRA are consistent with industry experience for these combinations of materials and environments. On the basis of its review, the staff finds that all applicable aging effects were identified, and the aging effects listed are appropriate for the combination of materials and environments identified.

3.3.36.2.2 Aging Management Programs

Section 2.3.3.36 and Table 3.3-45, page 3.3-256, of the LRA state that the following aging management programs are credited for managing the aging effects in the turbine building sump pump system.

- Inspection Program for Civil Engineering Structures and Components
- Fluid Leak Management Program
- Sump Pump Systems Inspection

The Fluid Leak Management Program, Inspection Program for Civil Engineering Structures and Components, and Sump Pump Systems Inspection program are credited with managing the aging effects of several components in different structures and systems and are, therefore, considered common aging management programs. The staff has evaluated these common AMPs and found them to be acceptable for managing the aging effects identified for this system. The staff's evaluation of these AMPs is documented in Section 3.0 of this SER.

Based on its review of LRA Table 3.3-45, the staff concludes that the above identified AMPs will effectively manage the aging effects of the turbine building sump pump system, and that there is reasonable assurance that the intended functions of the turbine building sump pump system will be maintained consistent with the current licensing basis during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.36.3 Conclusions

The staff reviewed the information in Section 2.3.3.36 and Table 3.3-45, page 3.3-256, of the LRA. On the basis of its review, the staff concludes that the applicant has demonstrated that the aging effects associated with the turbine building sump pump system will be adequately managed, so that there is reasonable assurance that the system components will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).