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1650 Calvert Cliffs Parkway
Lusby, Maryland 20657
410 495-4455

BGE

July 30, 1997

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Request for Review and Approval of System Reports for License Renewal

REFERENCES:

(a) Letter from Mr. R. E. Denton (BGE) to NRC Document Control Desk, dated August 18, 1995, Integrated Plant Assessment Methodology

(b) Letter from Mr. D. M. Crutchfield (NRC) to Mr. C. H. Cruse (BGE), dated, April 8, 1996, Final Safety Evaluation (FSE) Concerning The Baltimore Gas and Electric Company Report entitled, Integrated Plant Assessment Methodology

(c) Letter from Mr. S. C. Flanders (NRC), dated March 4, 1997, "Summary of Meeting with Baltimore Gas and Electric Company (BGE) on BGE License Renewal Activities"

This letter forwards the attached Integrated Plant Assessment (IPA) System Reports for review and approval in accordance with 10 CFR Part 54, the license renewal rule. Should we apply for License Renewal, we will reference IPA System Reports as meeting the requirements of 10 CFR 54.21(a), "Contents of application-technical information," and the demonstration required by 10 CFR 54.29(a)(1), "Standards for issuance of a renewed license."

The information in these reports is accurate as of the dates of the references listed therein. Per 10 CFR 54.21(b), an amendment or amendments will be submitted that identify any changes to the current licensing basis that materially affect the content of the license renewal application.

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In Reference (a), Baltimore Gas and Electric Company submitted the IPA Methodology for review and approval. In Reference (b), the Nuclear Regulatory Commission (NRC) concluded that the IPA Methodology is acceptable for meeting 10 CFR 54.21(a)(2) of the license renewal rule, and if implemented, provides reasonable assurance that all structures and components subject to an aging management review pursuant to 10 CFR 54.21(a)(1) will be identified. Additionally, the NRC concluded that the methodology provides processes for demonstrating that the effects of aging will be adequately managed pursuant to 10 CFR 54.21(a)(3) that are conceptually sound and consistent with the intent of the license renewal rule.

In Reference (c), the NRC stated that if the format and content of these reports met the requirements of the template developed by BGE, the NRC could begin the technical review. This report has been produced and formatted in accordance with these guidance documents. We look forward to your comments on the reports as they are submitted and your continued cooperation with our license renewal efforts.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

Charles H. Cruse

STATE OF MARYLAND :
: **TO WIT:**
COUNTY OF CALVERT :

I, Charles H. Cruse, being duly sworn, state that I am Vice President, Nuclear Energy Division, Baltimore Gas and Electric Company (BGE), and that I am duly authorized to execute and file this response on behalf of BGE. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other BGE employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

Charles H. Cruse

Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of Calvert, this 30th day of July, 1997.

WITNESS my Hand and Notarial Seal: Denise Snickis
Notary Public

My Commission Expires: 2/2/98
Date

CHC/SJR/dlm

Attachments: (1) Appendix A - Technical Information; 5.3 - Component Cooling System
(2) Appendix A - Technical Information; 5.4 - Compressed Air System

cc: R. S. Fleishman, Esquire
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ATTACHMENT (1)

APPENDIX A - TECHNICAL INFORMATION

5.3 - COMPONENT COOLING SYSTEM

Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Power Plant
July 30, 1997

5.3 Component Cooling System

This is a section of the Baltimore Gas and Electric Company (BGE) License Renewal Application (LRA) addressing the Component Cooling (CC) System. The CC System was evaluated in accordance with the Calvert Cliffs Nuclear Power Plant (CCNPP) Integrated Plant Assessment (IPA) Methodology described in Section 2.0 of the BGE LRA. These sections are prepared independently and will, collectively, comprise the entire BGE LRA.

5.3.1 Scoping

System level scoping describes boundaries for plant systems and structures, develops screening tools which capture the 10 CFR 54.4(a) scoping criteria, and then applies the tools to identify systems and structures within the scope of license renewal. Component level scoping describes the components within the boundaries of those systems and structures that contribute to the intended functions. Scoping to determine components subject to aging management review (AMR) begins with a listing of passive intended functions and then dispositions the component types as either only associated with active functions, subject to replacement, or subject to AMR either in this report or another report.

Section 5.3.1.1 presents the results of the system level scoping, 5.3.1.2 the results of the component level scoping, and 5.3.1.3 the results of scoping to determine components subject to AMR.

Representative historical operating experience pertinent to aging is included in appropriate areas, to provide insight supporting the aging management demonstrations. This operating experience was obtained through key-word searches of BGE's electronic database of information on the CCNPP dockets and through documented discussions with currently assigned cognizant CCNPP personnel.

5.3.1.1 System Level Scoping

This section begins with a description of the system which includes the boundaries of the system as it was scoped. The intended functions of the system are listed and are used to define what portions of the system are within the scope of license renewal.

System Description/Conceptual Boundaries

The CC System is designed to remove heat from various power plant auxiliary systems. The Saltwater (SW) System provides the cooling medium for the CC heat exchangers. The CC System serves as an intermediate barrier between the various supplied auxiliary systems and the SW System. System components are rated for maximum duty requirements during normal and shutdown cooling operation and are also capable of removing heat during a loss-of-coolant accident. [Reference 1, Section 1.1.1]

The CC System for each unit consists of three motor-driven CC circulating pumps, two CC heat exchangers, a head tank, a chemical additive tank, associated valves, piping, instrumentation, and controls. [Reference 1, Section 1.1.1]

The CC heat exchangers are designed for a CC supply temperature of 95°F, with a saltwater cooling supply temperature of 90°F, at normal operating conditions. The CC System fluid may reach a temperature as high as 120°F during a loss-of-coolant accident prior to a recirculation actuation signal (RAS), and during plant cool-down and cold shutdowns. [Reference 2, Section 9.5.2.1]

A head tank allows for expansion of the CC System water and provides sufficient net positive suction head for the CC pumps. Makeup can be added to the CC System to maintain head tank level. The source of makeup water is the plant Demineralized Water System. Additional makeup capacity may be provided from the Condensate System. [Reference 2, Section 9.5.2.1]

A chemical additive tank connected to the system permits maintenance of the proper corrosion inhibitor concentration in the CC System. Calvert Cliffs Updated Final Safety Analysis Report Figures 9-6 (Unit 1) and 9-25 (Unit 2) show the schematic diagram of the CC System. The components cooled by the CC System include the following: [Reference 2, Section 9.5.2.1]

- Letdown heat exchanger;
- Shutdown cooling heat exchangers;
- Miscellaneous waste processing heat exchanger;
- Waste gas compressor aftercoolers and jacket coolers;
- Control element drive mechanism coolers;
- Reactor coolant pump mechanical seals and lube oil coolers;
- Low pressure safety injection pump seals and coolers;
- High pressure safety injection pump seals and coolers;
- Containment penetration cooling;
- Reactor support cooling;
- Steam generator lateral support cooling;
- Coolant waste evaporators;
- Reactor coolant and miscellaneous waste sampling system;
- Degasifier vacuum pump cooler;
- Post-accident sample system; and
- Reactor coolant drain tank heat exchanger.

During normal plant operation, one of the CC pumps and one of the CC heat exchangers are required for cooling service. During normal RCS cool-down from 300°F to 140°F, two CC pumps and two CC heat exchangers are required to provide maximum heat removal. For long-term cooling following a loss-of-coolant accident, two CC pumps and two CC heat exchangers provide the necessary cooling capacity for both shutdown heat exchangers. Component cooling will be supplied to both shutdown cooling heat exchangers because of the normally-open cross-tie. [Reference 2, Section 9.5.2.1]

The CC pump motors are supplied from two separate 480 volt engineered safety feature busses, with the third pump motor having two breakers, one from each bus. If a loss of offsite power occurs, the pumps' electrical power requirements can be supplied by the emergency diesel generators. During normal shutdown cooling, two pumps are running with the third pump on standby. If low discharge header pressure is annunciated in the Control Room, the operator can start the third pump. [Reference 2, Section 9.5.2.1]

The CC System is comprised of the following equipment types: [Reference 1, Section 1.1.2]

Piping/tubing	Transport cooling water from the CC pumps to the various loads.
Valves	Control, pressure control, check, hand, solenoid and relief valves that provide containment isolation and system alignment/isolation; automatic vents that release air from the system.
Instruments	Measure flow rates, pressure, temperature, and radiation. Provide alarm and initiate automatic corrective action.
Pumps	Pump cooling water through CC heat exchangers to reactor plant and auxiliary system components.
Heat Exchangers	Transfer heat from reactor plant and auxiliary system components to the CC System and between the CC System and the SW System. Aging management review of the CC/SW Heat Exchangers is included with the SW System review in Section 5.16 of the BGE LRA, and review of the load heat exchangers for interfacing systems are included with the review of their respective systems.
Tanks	Act as surge volumes for the system and allow for chemical addition to system.

The CC System intended system functions are: [Reference 1, Section 1.1.3]

- Provide Containment Isolation during a Design Basis Event.
- Provide support as a vital auxiliary for Containment Spray process fluid cooling (via shutdown cooling heat exchanger) and high pressure safety injection and low pressure safety injection pump cooling.
- Provide information used to assess the plant and environs condition during and following an accident.
- Maintain functionality of electrical components as addressed by the Environmental Qualification (EQ) program.
- Provide a heat sink for essential shutdown cooling loads to ensure safe shutdown in the event of a postulated severe fire.
- Provide seismic integrity and protection of safety-related components.
- Maintain electrical continuity and provide protection of the electrical system.
- Maintain electrical continuity and provide protection of the electrical system (this includes only device types that perform the function by exhibiting motion or changing properties or configuration).
- Maintain the pressure boundary of the system (liquid).
- Provide alternate heat sink via the unaffected unit for essential shutdown cooling loads in the event of a severe fire in the CC Room.

System Operating Experience

The following are operating experiences related to the CC System with the potential for affecting the intended functions of the components or system.

Operating experience relative to the CC heat exchangers is located in the SW License Renewal Technical Report in Section 5.16 of the BGE LRA. Operating experience events relevant to the CC System involve leakage from the CC cross-connect valves. Due to a combination of poor design and aging, some of the CC cross-connect valves were experiencing minor leakage. Baltimore Gas and Electric Company removed and replaced the CC System cross-connect valves with an upgraded valve design. There has been no further observable valve leakage since the replacement of the CC cross-connect valves.

Calvert Cliffs has experienced water hammers in the CC System while switching the CC pumps. The cause of these water hammers was determined to originate from CC pump outlet check valves. Baltimore Gas and Electric Company plans to replace these check valves to eliminate further water hammer.

The CC System operational history has shown that it is a very leak tight system, which typically leaks less than one gallon per minute during normal operation (due to pump, auto vents, and valve packing leakage). During inspection of the CC System it was noted that a very tightly adhering layer of magnetite has formed on the interior surfaces of the system. The formation of a passive oxide layer (magnetite) on the interior surface of the CC components protects them from corrosion by minimizing the exposure of bare metal to system fluids.

These events demonstrate that CCNPP inspects, maintains, and upgrades the CC System to ensure that the CC components remain capable of performing their intended function under current licensing basis (CLB) conditions.

System Interfaces

Figure 5.3-1 shows the CC System flow path and components, including the systems and components that interface with the CC System. A list of CC System interfaces is given below: [Reference 1, Section 1.1.2]

- Demineralized Water System
- Condensate System*
- Radiation Monitoring System*
- Saltwater System*
- Miscellaneous Waste Processing System
- Reactor Coolant Pumps*
- Chemical and Volume Control System*
- Control Element Drive Mechanism Cooling System*
- Reactor Vessel Supports and Steam Generator Lateral Supports*
- Safety Injection System and Shutdown Cooling Heat Exchangers*
- High Pressure Safety Injection Pumps*

- Low Pressure Safety Injection Pumps*
- Containment Penetrations*
- Waste Evaporator System
- Waste Gas System
- Reactor Coolant Waste Processing System
- Miscellaneous Waste Processing System Heat Exchanger
- Reactor Coolant and Waste Process Sample System*
- Gas Analyzing System
- Engineered Safety Features Actuation System*

The CC System interfaces listed above are not all within the scope of license renewal. Those systems or system components interfacing with the CC System that are within the scope of license renewal are noted with an asterisk (*) above and in Figure 5.3-1. The asterisk indicates that the system or component is within the scope of license renewal. However, the CC System at that interface may not be within the scope of license renewal (i.e., non-safety-related CC piping at the reactor vessel and steam generator lateral supports). Where a system, component, commodity, or structure interface is in scope for license renewal, that system will be addressed by the respective section of this application for that system, component, commodity, or structure.

SIMPLIFIED DIAGRAM
(FOR INFORMATION ONLY)

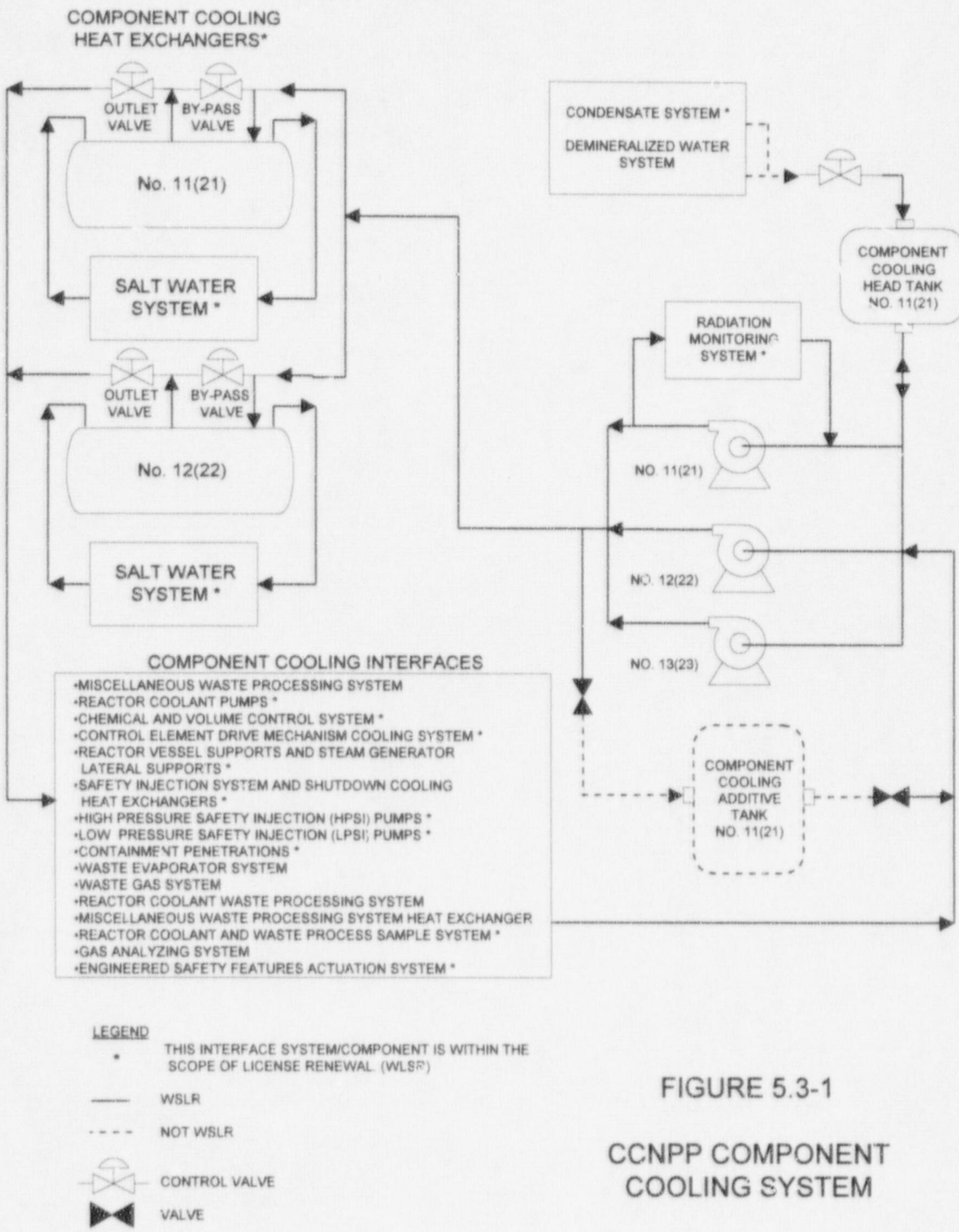

FIGURE 5.3-1

CCNPP COMPONENT COOLING SYSTEM

System Scoping Results

The CC System is in the scope for license renewal based on 10 CFR 54.4(a). In accordance with Section 4.1.1 of the CCNPP IPA Methodology, the following system intended functions were determined based on the requirements of 10 CFR 54.4(a)(1) and (2): [Reference 3, Table 1]

- To provide containment isolation;
- To act as a vital auxiliary for containment spray process fluid cooling (via shutdown cooling heat exchangers) and high pressure safety injection/low pressure safety injection pump cooling;
- To provide seismic integrity and/or protection of safety-related components;
- To maintain electrical continuity and/or provide protection of the electrical system; and
- To maintain the pressure boundary of the system liquid

The following intended functions of the CC System were determined based on the requirements of 10 CFR 54.4(a)(3): [Reference 3, Table 1]

- For EQ (§50.49) - Maintain functionality of the electrical components as addressed by the EQ program.
- For fire protection (§50.48) - Provide heat sink for essential shutdown cooling loads to ensure safe shutdown in the event of a postulated severe fire.
- For fire protection (§50.48) - Provide alternative heat sink via the unaffected unit for essential shutdown cooling loads in the event of a severe fire at the CC Room.
- For post-accident monitoring - To provide information used to assess the environs and plant condition during and following a Design Basis accident.

All of the CC components performing 10 CFR 54.4(a)(1) and (2) intended functions are safety related, and component ratings and construction information is identified in the Updated Final Safety Analysis Report Section 9.5, Table 9-17.

5.3.1.2 Component Level Scoping

Based on the intended functions listed above, the portion of the CC System that is within the scope of license renewal includes equipment types that consist of: piping; components (i.e., heat exchangers, pumps, valves, and tanks); supports; instrumentation; and cables for the section of the system relied on for mitigation of Design Basis Events, EQ and fire protection.

A total of 36 device types within these CC equipment types were designated as within the scope of license renewal based on these intended functions. These device types are listed in Table 5.3-1. [Reference 1, Section 2.2]

Several component types are common to many plant systems and perform the same passive functions regardless of system. These component types are listed below:

- Structural supports for piping, cables and components;
- Electrical cabling; and

- Process and instrument tubing, instrument tubing manual valves, and tubing supports for components.

5.3.1.3 Components Subject to Aging Management Review

This section describes the components of the CC System which are subject to an AMR. It begins with a listing of passive intended functions and then dispositions the device types previously listed as either associated with active functions, subject to replacement, evaluated in other reports, evaluated in commodity reports, or remaining to be evaluated for aging management in this section.

Passive Intended Functions

In accordance with the CCNPP IPA Methodology Section 5.1, the following CC System functions were determined to be passive: [Reference 1, Table 3-1]

- To maintain the pressure boundary of the system liquid;
- To provide seismic integrity and/or protection of safety-related (SR) components; and
- To maintain electrical continuity and/or provide protection of the electrical system.

TABLE 5.3-1

COMPONENT COOLING
DEVICE TYPES WITHIN THE SCOPE OF LICENSE RENEWAL

Device Type	Device Code
• Piping Line	(-HB)
• Automatic Vent	(AVV)
• Check Valve	(CKV)
• Coil	(COIL)
• Control Valve	(CV)
• Disconnect Switch/Link	(DISC)
• Voltage/Current Device	(E/I)
• Fuse	(FU)
• Hand Switch	(HS)
• Hand Valve	(HV)
• Heat Exchanger	(HX)
• Ammeter	(II)
• Power Light Indicator	(JL)
• Level Gage	(LG)
• Level Switch	(LS)
• Level Transmitter	(LT)
• 480V Motor	(MB)
• 125/250 VDC Motor	(MD)
• Pressure Differential Indicator	(PDIS)
• Pressure Indicator	(PI)
• Panel	(PNL)
• Pressure Switch	(PS)
• Pressure Transmitter	(PT)
• Pump/Driver Assembly	(PUMP)
• Radiation Element	(RE)
• Relief Valve	(RV)
• Relay	(RY)
• Solenoid Valve	(SV)
• Temperature Element	(TE)
• Temperature Indicator	(TI)
• Temperature Indicator Alarm	(TIA)
• Temperature Indicating Controller	(TIC)
• Tank	(TK)
• Power Supply	(YX)
• Position Indicating Lamp	(ZL)
• Position Switch	(ZS)

Device Types Subject to Aging Management Review

The device types of the CC System, and the associated supports, cables, and tubing, were reviewed and were dispositioned as follows: [Reference 1, Section 3-2, Table 3-2]

- Fifteen device types including the coil, disconnect link switch, voltage/current device, fuse, hand switch, ammeter, power light indicator, 480 VAC motor, 125/250 VDC motor, pressure indicator, relay, temperature indicating alarm, power supply, position indicating lamp and position switch are only associated with active functions.
- The pressure transmitter device type is subject to replacement.
- The CC heat exchanger is evaluated in the SW System section (Section 5.16) of the BGE LRA.
- Six device types including the level gauge, level switch, level transmitter, differential pressure indicating switch, and pressure switch are evaluated in the Instrument Lines Commodity Evaluation in Section 6.4 of the BGE License Renewal. The sixth device type, panel, is dispositioned in the Electrical Panels Commodity Evaluation in Section 6.2 of the BGE LRA.
- Structural supports for piping, cables and components in the CC System that are subject to AMR are evaluated for the effects of aging in the Component Supports Commodity Evaluation in Section 3.1 of the BGE LRA. This commodity evaluation completely addresses the CC System passive intended function, "To provide seismic integrity and/or protection of safety-related components."
- Maintaining functionality of the electrical components in the CC System that are subject to AMR is evaluated for the effects of aging in the EQ Commodity Evaluation in Section 6.3 of the BGE LRA. This commodity evaluation completely addresses the CC System intended function, "To maintain functionality of electrical components."
- Electrical cabling for components in the CC System that are subject to AMR is evaluated for the effects of aging in the Cables Commodity Evaluation in Section 6.1 of the BGE LRA. This commodity evaluation completely addresses the CC System passive intended function, "To maintain electrical continuity and/or provide protection of the electrical system."
- Instrument tubing and piping, instrument valves, and fittings (generally everything from the outlet of the final root valve up to and including the instrument) are all evaluated for the effects of aging in the Instrument Lines Commodity Evaluation in Section 6.4 of the BGE LRA. This commodity evaluation addresses the CC System passive intended function, "To maintain the pressure boundary of the system (liquid)."

As a result of the evaluations described above, the only passive function associated with the CC System not previously dispositioned is the following:

- To maintain the pressure boundary of the system (liquid).

Of the 36 device types originally within the scope of license renewal, 13 device types remain that have this passive intended function (pressure boundary) and are long-lived. These 13 CC device types are exposed to treated demineralized water and are listed in Table 5.3-2. The 13 device types are subject to AMR for the CC System, and are the subject of the remainder of this report. [Reference 1, Table 3-2]

TABLE 5.3-2
DEVICE TYPES REQUIRING AMR FOR COMPONENT COOLING SYSTEM

Piping (-HB)
Automatic Vent (AVV)
Check Valve (CKV)
Control Valve (CV)
Hand Valve (HV)
Pump/Driver Assembly (PUMP)
Radiation Element (RE)
Relief Valve (RV)
Solenoid Valve (SV)
Temperature Element (TE)
Temperature Indicator (TI)
Temperature Indicating Controller (TIC)
Tank (TK)

5.3.2 Aging Management

The list of potential Age-Related Degradation Mechanisms (ARDMs) identified for the CC System device types is given in Table 5.3-3. The plausible ARDMs are identified in the table by a check mark (✓) in the appropriate column. For the AMR, some CC device types have a number of groups associated with them because of the diversity of materials used in their fabrication. A check mark (✓) indicates that the ARDM applies to at least one group for the device type listed. The device types listed in Table 5.3-3 are those previously identified in Table 5.3-2 as passive and long-lived. [Reference 1, Table 4-1, 4-2] For efficiency in presenting the results of these evaluations in this report, ARDM/device type combinations are grouped where there are similar characteristics and the discussion is applicable to all device types within that group. Exceptions are noted where appropriate. For this report the device types are grouped according to ARDMs.

The following discussions present information on plausible ARDMs. The discussions are grouped by ARDM, the device type groups that are affected by each, the materials and environment pertinent to the ARDM, the methods to manage aging, aging mechanism effects, and the aging management program(s). There is then a summary of the aging management demonstration. The groups addressed here are:

Group 1 - crevice corrosion/pitting;
Group 2 - erosion corrosion;
Group 3 - general corrosion;
Group 4 - rubber degradation;
Group 5 - selective leaching; and
Group 6 - wear.

Crevice corrosion and pitting are grouped together in this report because they both affect the same device type groups, have similar effects, and are covered by the same aging management programs.

TABLE 5.3-3

POTENTIAL AND PLAUSIBLE ARDMs FOR THE COMPONENT COOLING SYSTEM

Potential ARDMs	Device Types for Which ARDM is Plausible												
	-HB	AVV	CKV	CV	HV	PUMP	RE	RV	SV	TE	TI	TIC	TK
Cavitation Corrosion													
Corrosion Fatigue													
Crevice Corrosion	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)
Dynamic Loading													
Electrical Stressors													
Erosion/Corrosion	✓(2)												
Fatigue													
Fouling													
Galvanic Corrosion													
General Corrosion	✓(3)		✓(3)	✓(3)	✓(3)	✓(3)		✓(3)		✓(3)	✓(3)		✓(3)
Hydrogen Damage													
Intergranular Attack													
MIC													
Particulate Wear Erosion													
Pitting	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)	✓(1)
Radiation Damage													
Rubber Degradation				✓(4)									
Saline Water Attack													
Selective Leaching		✓(5)		✓(5)	✓(5)			✓(5)	✓(5)				
Stress Corrosion Cracking													
Thermal Damage													
Thermal Embrittlement													
Wear			✓(6)	✓(6)				✓(6)					

MIC - Microbiologically Influenced Corrosion
✓ indicates plausible ARDM determination
(#) indicates the group in which this ARDM is evaluated

Note: Not every group within the device types listed here may be susceptible to a given ARDM. This is because groups within a device type are not always fabricated from the same materials. Exceptions for each device type will be indicated in the aging management section for each ARDM discussed in this report.

Group 1 (crevice corrosion/pitting) - Materials and Environment

Table 5.3-3 shows that crevice corrosion/pitting is plausible for all the device types listed. The following CC System device types, and the material characteristics which are susceptible to these ARDMs, are listed below: [Reference 1, Attachment 1 and -HB01, AVV01, CV01/02/03/04/05, CKV01/02, HV01/02/03/04/05/06/07, PUMP01, RE01, RV01, RV01/02/03, SV01, T101, TIC01, TK01 Attachments 4, 5 and 6]

- Piping - carbon steel;
- Automatic vents - cast brass base and shell with stainless steel float/pins;

- Check valves - some have carbon steel bodies and discs;
- Control valves - some groups have carbon steel bodies, some have stainless steel bodies, shafts and discs, some have cast iron bodies, and some have aluminum bronze discs;
- Hand valves - some groups have carbon steel bodies; some have stainless steel bodies, stems, and discs; and some have cast iron bodies/discs;
- Pump - carbon steel casing;
- Radiation elements - stainless steel;
- Relief valve - some groups have carbon steel bodies; some have stainless steel bodies, seat, and disc; some have bronze bodies, and brass seats and discs;
- Solenoid valve - brass;
- Temperature elements - carbon steel (TE included in TI device type in Reference 1, Attachment 1);
- Temperature indicators - carbon steel;
- Temperature indicating controllers - stainless steel; and
- Tanks - carbon steel.

The internal environment of the CC System is chemically-treated water at a design pressure of 150 psig and a maximum design temperature of 180°F. [Reference 2, Section 9.5.2.1, Table 9-17] The CC System includes of a number of components (i.e., valves, instruments) that are flange bolted, welded in place, or are gasketed. Within the CC System there are regions of low or stagnant coolant flow conditions.

Group 1 (crevice corrosion/pitting) - Aging Mechanism Effects

Crevice corrosion is intense, localized corrosion within crevices or shielded areas. It is associated with a small volume of stagnant solution caused by holes, gasket surfaces, lap joints, crevices under bolt heads, surface deposits, designed crevices for attaching thermal sleeves to safe-ends, and integral weld backing rings or back-up bars. The crevice must be wide enough to permit liquid entry and narrow enough to maintain stagnant conditions, typically a few thousandths of an inch or less. Crevice corrosion is closely related to pitting and can initiate pits in many cases. In an oxidizing environment, a crevice can set up a differential aeration cell to concentrate an acid solution within the crevice. Even in a reducing environment, alternate wetting and drying can concentrate aggressive ionic species to cause pitting and crevice corrosion. Pitting is a form of localized attack with greater corrosion rates at some locations than at others. These pits are, in many cases, filled with oxide debris, especially in ferritic materials such as carbon steel. Deep pitting is more common with passive metals, such as austenitic stainless steels, than with non-passive metals. In many cases, erosion corrosion, fretting corrosion, and crevice corrosion can also lead to pitting. It can also occur at locations of relatively stagnant coolant or water, such as in carbon steel piping of cooling systems. [Reference 1, Pipe-Attachment 7]

Long-term exposure to environments conducive to these ARDMs may result in crevice corrosion/pitting which, if left unmanaged, could eventually result in loss of material and pressure-retaining capability under CLB design loading conditions. Therefore, crevice corrosion/pitting have been determined to be plausible ARDMs for which aging effects must be managed for the CC System.

Group 1 (crevice corrosion/pitting) - Methods to Manage Aging

Mitigation: Maintaining an environment of purified water with controls on pH, suspended solids, and chlorides during normal plant operation can mitigate this ARDM. [Reference 1, Pipe Attachment 6] The initial formation of a passive oxide layer (magnetite) on the interior surface also mitigates the effects of crevice corrosion/pitting by minimizing the exposure of bare metal to system fluids.

Discovery: Inspection of a representative sample of susceptible areas of the system for the signs of crevice corrosion/pitting could identify whether this ARDM is actually occurring in the CC System. Maintenance/overhaul of CC System components also provides opportunities to inspect for signs of crevice corrosion/pitting.

Group 1 (crevice corrosion/pitting) - Aging Management Program(s)

Mitigation: Calvert Cliffs Chemistry Procedure (CP) CP-206, "Specifications and Surveillance for Component Cooling/Service Water Systems," provides for monitoring and maintaining CC chemistry to control the concentrations of oxygen, chlorides, other chemicals, and contaminants. The water is treated with hydrazine to minimize the amount of oxygen in the water which aids in the prevention and control of most corrosive mechanisms. Continued maintenance of system water quality will ensure minimal piping or component degradation. [Reference 1, Attachment 8]

Procedure CP-206 describes the surveillance and specifications for monitoring the CC System fluid. Procedure CP-206 lists the parameters to monitor, the frequency of monitoring these parameters, and the Target and Action Levels for the CC System fluid parameters. The parameters monitored by CP-206 are pH, hydrazine, chloride, dissolved oxygen, dissolved copper, dissolved iron, suspended solids, gamma activity, and tritium activity (normally not a radioactive system). [Reference 4, Attachment 1]

These chemistry parameters are currently monitored on a frequency ranging from three times per week to once a month. All of the parameters listed in CP-206 currently have target values that give an acceptable range or limit for the associated parameter. Two of the parameters, pH and hydrazine, have Action Levels associated with them. For pH the current Action Level is less than 9.0 or greater than 9.8; for hydrazine the current Action Level is less than 5 or greater than 25 parts per million (ppm). Refer to Attachment 1 in CP-206 for the specific monitoring frequency and Target Values for each chemistry parameter. [Reference 4, Attachment 1]

Operational experience related to CP-206 has shown no problems related to use of this procedure with respect to the CC System. In 1996, CP-206 was revised to include dissolved iron as a chemistry parameter. Dissolved iron was added as a parameter to CP-206 to discover any unusual corrosion of the CC carbon steel components.

An internal BGE chemistry summary report for 1996 described the CCNPP Unit 1 and Unit 2 CC/SRW Systems' chemistry as excellent. Action levels for all four systems were only exceeded on eight occasions, or approximately 0.7% of the time during the year. Over 70% of the Action Levels exceeded were due to major system changes during the 1996 refueling outage. Recommendations to correct this condition have been made to determine outage evolutions that can affect the CC/SRW chemistry and take action to prevent chemistry targets being exceeded.

The CC System usually operates within normal parameters, except when the system is restarted after an outage lay-up. During an outage lay-up, the CC System experiences some minor corrosion when the internal component surfaces are exposed to air. After the CC System is returned to service and flow is once again established, some of this minor corrosion is removed from the pipe inner surface and released into the system where it is detected. An increase in suspended solids (due to this effect) was seen on Unit 1 at the start of the 1996 outage, and was correlated to flow initiation through the Shutdown Cooling Heat Exchangers. The level of suspended solids slowly decreased over the course of the year back to levels obtained before the outage. The Unit 2 suspended solids showed a fairly steady baseline with a few minor spikes occurring during the year.

Procedure CP-206 provides for a prompt review of CC chemistry parameters so that steps can be taken to return chemistry parameters to normal levels, and thus minimizes the effects of crevice corrosion/pitting.

Discovery: Although minimal corrosion is expected, the CC System will be included in the Age Related Degradation Inspection (ARDI) Program to verify that degradation of the components is not occurring. However, the ARDI Program will not necessarily be used for the discovery of crevice corrosion/pitting in the CC relief valves or pumps, as discussed later. The ARDI Program guidelines are outlined in the CCNPP IPA Methodology presented in Section 2.0. of the BGE LRA.

The elements of the ARDI Program will include:

- Determination of the examination sample size based on plausible aging effects;
- Identification of inspection locations in the system/component based on plausible aging effects and consequences of loss of component intended function;
- Determination of examination techniques (including acceptance criteria) that would be effective, considering the aging effects for which the component is examined;
- Methods for interpretation of examination results;
- Methods for resolution of adverse examination findings, including consideration of all design loading conditions required by the CLB, and specification of required corrective actions based on the CCNPP Corrective Action Program; and
- Evaluation of the need for follow-up examinations to monitor the progression of any age-related degradation.

The CC pumps are inspected for crevice corrosion/pitting using the CCNPP PUMP-14, "Component Cooling Pump Overhaul," procedure. PUMP-14 currently instructs the user to inspect the pump impeller and shaft for erosion, corrosion/pitting, and inspect all pump parts for wear, corrosion, and mechanical damage. The procedure directs the user to contact the System Engineer if any of these indications are found, and replace parts as necessary. [Reference 5] Previous CC pump overhauls at CCNPP did not reveal any problems associated with crevice corrosion/pitting or any other corrosion mechanisms.

Any corrective actions that are required will be taken in accordance with the CCNPP Corrective Action Program, and will ensure that the components will remain capable of performing their intended function under all CLB conditions.

Group 1 (crevice corrosion/pitting) - Demonstration of Aging Management

Based on the information presented above, the following conclusions can be reached with respect to corrosion of the CC System device types susceptible to crevice corrosion/pitting:

- The CC device types susceptible to these ARDMs have an intended function that must be maintained under CLB design loading conditions.
- Crevice corrosion/pitting is plausible for the device types discussed in the material and environment section above, which could lead to loss of pressure-retaining boundary integrity.
- The CCNPP CP-206, "Specification and Surveillance CC/SRW System," will mitigate the effects of crevice corrosion/pitting on CC System device types by controlling the range of specific chemical parameters, and provide Action Levels that ensure timely correction of adverse chemistry parameters.
- The CCNPP ARDI Program will assess the potential for crevice corrosion/pitting in the CC System. Appropriate corrective action will be taken if crevice corrosion/pitting is discovered.
- The CCNPP PUMP-14, "Component Cooling Pump Overhaul," requires the inspection of the pump for crevice corrosion/pitting. Any indications of these ARDMs will be reported to the System Engineer and corrective actions taken.

Therefore, there is reasonable assurance that the effects of crevice corrosion/pitting on CC System device types will be managed in order to maintain their intended function under all design loading conditions required by the CLB during the period of extended operation.

Group 2 (erosion corrosion) - Materials and Environment

Table 5.3-3 shows that erosion corrosion is only plausible for the CC System piping. The CC System piping is made from carbon steel that is fabricated into straight sections, bends, and tees. The CC System is chemically treated with hydrazine to lower the dissolved oxygen level. [Reference 1, Pipe-Attachments 4, 5, and 6] The system has a design pressure of 150 psig and a maximum design temperature of 180°F. [Reference 2, Section 9.5, Table 9-17]

Group 2 (erosion corrosion) - Aging Mechanism Effects

Carbon steel piping bends, tees, and areas with flow disturbances are especially vulnerable to erosion corrosion. The CC System is treated with hydrazine which scavenges the dissolved oxygen and minimizes the effects of general corrosion. However, the lower oxygen content increases the susceptibility of the piping to the effects of erosion corrosion. The expected effect of erosion corrosion is a general thinning of the material in areas of higher turbulence due to removal of the protective magnetite coating. [Reference 1, Pipe-Attachment 6]

The occurrence of erosion corrosion is highly dependent upon material of construction and the fluid flow conditions. Carbon or low alloy steels are particularly susceptible when in contact with high velocity water (single or two phase) with flow disturbances, low oxygen levels, and a fluid pH < 9.3. Maximum erosion corrosion rates are expected in carbon steel at 130-140°C (single phase) and 180°C (two phase). [Reference 1, Pipe-Attachment 7]

Long-term exposure to erosion corrosion could lead to material loss which, if unmanaged, could eventually result in loss of the pressure-retaining capability under CLB design loading conditions. Therefore, erosion corrosion has been determined to be a plausible ARDM for which aging effects must be managed for the CC System.

Group 2 (erosion corrosion) - Methods to Manage Aging

Mitigation: The effects of erosion corrosion can be mitigated by selecting resistant materials and/or maintaining optimal fluid chemistry conditions. The normal CC System operating temperature is below that expected for maximum erosion corrosion conditions. The low flow velocity in the CC System also minimizes its susceptibility to erosion corrosion.

Discovery: Erosion corrosion can be discovered and monitored by nondestructive examination of potentially affected areas. Inspection of a representative sample of susceptible areas of the system for the signs of erosion corrosion could identify whether this ARDM is a concern in the CC System piping.

Group 2 (erosion corrosion) - Aging Management Program(s)

Mitigation: There are no programs credited with mitigating the effects of erosion corrosion on CC System piping.

Discovery: The CC System piping will be included in the ARDI Program to verify that degradation of this piping is not significant. This program will examine representative piping to determine if the wall thickness will remain sufficient for it to perform its intended function under all CLB conditions. These examinations will be performed prior to the period of extended operation. For further discussion of the ARDI Program, see the Group 1 (crevice corrosion/pitting) discussion for Aging Management Programs under Discovery. [Reference 1, Attachment 1]

During inspection of some open pipe locations it was revealed that a tightly adhering layer of magnetite is present on the inside of the CC piping. Evidence of erosion corrosion was not found during these system lay-up examinations. The evidence of tightly adhering magnetite indicates that the piping has good corrosion resistant characteristics. To date, there have been no indications of erosion corrosion in the CC System.

Group 2 (erosion corrosion)- Demonstration of Aging Management

Based on the information presented above, the following conclusions can be reached with respect to the CC System piping and erosion corrosion:

- The CC System piping provides a pressure-retaining boundary, so its integrity must be maintained under CLB design conditions.

- Erosion corrosion is expected to be minimal, but is considered plausible for the CC System piping; this could result in the loss of component material and lead to the loss of the pressure-retaining boundary.
- The CCNPP ARDI Program will be utilized to examine representative piping and discover any potential erosion corrosion that may occur. Inspections will be performed, and appropriate corrective action will be taken if erosion corrosion is discovered.

Therefore, there is reasonable assurance that the effects of erosion corrosion will be adequately managed to maintain the CC System piping pressure boundary integrity consistent with the CLB during the period of extended operation.

Group 3 (general corrosion) - Materials and Environment

Table 5.3-3 shows that general corrosion is plausible for nine of the CC device types. The CC System device types susceptible to general corrosion, and the material characteristics which are susceptible to this ARDM are listed below: [Reference 1, Attachment 1 and -HB01, CKV01/02, CV01/02/03/05, HV01/02/03/04/05/07, PUMP01, RV102, TI01, TK01 Attachments 4, 5 and 6]

- Piping - carbon steel;
- Check valves - those groups with carbon steel bodies and/or discs;
- Control valves - those groups with carbon steel bodies and cast iron bodies;
- Hand valves - those groups with carbon steel bodies and cast iron bodies;
- Pump - carbon steel casings;
- Relief valves - those groups with carbon steel bodies;
- Temperature element - carbon steel. (TE included in TI device type in Reference 1, Attachment 1);
- Temperature indicator - carbon steel; and
- Tank - carbon steel.

The internal environment of the CC System is chemically-treated water at a design pressure of 150 psig and a maximum design temperature of 180°F. [Reference 2, Section 9.5.2.1, Table 9-17] The external environment is ambient atmospheric air inside the Containment and Auxiliary Buildings which is climate controlled. During normal operation the Auxiliary Building, ambient air maximum design relative humidity is 70%, with a maximum design temperature of 160°F (Main Steam Penetration Room). [Reference 6, Attachment 1, Table 1, page 5 of 14]

Group 3 (general corrosion) - Aging Mechanism Effects

Carbon steel and cast iron are susceptible to general corrosion mechanisms in a water environment. General corrosion is the thinning (wastage) of a metal by chemical attack (dissolution) at the surface by an aggressive environment. The consequences of the damage are the loss of load carrying cross-sectional area of the metal. [Reference 1, Attachment 6s] The ARDM is plausible for the device types discussed in the material and environment section above.

Long-term exposure to an internal chemical environment and potential external corrosive chemical environment may result in general corrosion/area material loss which, if unmanaged, could eventually result in loss of the pressure-retaining capability under CLB design loading conditions. Therefore, general corrosion has been determined to be a plausible ARDM for which aging effects must be managed for the CC System.

Group 3 (general corrosion) - Methods to Manage Aging

Mitigation: The effects of general corrosion can be mitigated on the interior of CC System equipment with chemistry control that monitors pertinent chemical parameters on a frequency that would prevent these parameters from reaching values that could create an environment conducive to general corrosion.

The effects of general corrosion on the CC equipment exterior surfaces can be mitigated through the use of protective coatings and removal of any potentially corrosive materials on component surfaces.

Discovery: Inspecting a representative sample of susceptible areas of the CC System for the signs of general corrosion prior to the period of extended operation can determine whether this ARDM is degrading the intended function of the CC System components. Maintenance/overhaul of CC System components also provides opportunities to inspect for signs of general corrosion.

Group 3 (general corrosion) - Aging Management Program(s)

Mitigation: Procedure CP-206 provides for monitoring of the CC chemistry to control the concentrations of oxygen, chlorides, other chemicals and contaminants. The water is treated with hydrazine to minimize the amount of dissolved oxygen, which aids in minimizing most corrosive mechanisms. Continued maintenance of system water quality will ensure minimal interior piping or component degradation. [Reference 1, Attachment 8]

Discovery: The occurrence of general corrosion is expected to be limited and is not likely to affect the intended function of the system components. The ARDI Program is intended to provide the additional assurance needed to conclude that the effects of plausible aging are being effectively managed for the period of extended operation. The ARDI Program will focus on the effects of plausible ARDMs and the affected components. The results from implementation of the ARDI Program are to be used to determine actions required to ensure that the affected components continue to support the identified passive intended functions throughout the period of extended operation. [Reference 1, Attachment 8] For further details of the ARDI Program, refer to the discussion under Group 1 (crevice corrosion/pitting) - Aging Management Programs.

The CC pumps are inspected for general corrosion using the CCNPP PUMP-14, "Component Cooling Pump Overhaul," procedure. PUMP-14 currently instructs the user to inspect the pump impeller and shaft for erosion, corrosion/pitting, and inspect all pump parts for wear, corrosion, and mechanical damage. The procedure directs the user to contact the System Engineer if any of these indications are found, and replace parts as necessary. [Reference 5]

Group 3 (general corrosion) - Demonstration of Aging Management

Based on the information presented above, the following conclusions can be reached with respect to the general corrosion of CC System equipment:

- The CC System device types subject to this ARDM provide a pressure-retaining boundary function, so their integrity must be maintained under CLB design loading conditions.
- General corrosion is plausible for some of the CC System device types which could lead to material loss and impaired capability of the components to perform their passive intended function of retaining the CC pressure boundary.
- The CCNPP CP-206, "Specification and Surveillance CC/SRW System," is a program that will mitigate the effects of general corrosion on CC System device types by controlling the range of specific chemical parameters, and provides Action Levels that ensure timely correction of adverse chemistry parameters.
- The CCNPP ARDI Program will be utilized to discover general corrosion that may be of concern for the CC System. Inspections will be performed, and appropriate corrective action will be taken if general corrosion is discovered.
- The CCNPP PUMP-14, "Component Cooling Pump Overhaul," requires the inspection of the pump for general corrosion. Any indications of these ARDMs will be reported to the System Engineer and corrective actions taken.

Therefore, there is reasonable assurance that the effects of general corrosion will be adequately managed to maintain the CC System components' pressure boundary integrity intended function consistent with the CLB during the period of extended operation.

Group 4 (rubber degradation) - Materials and Environment

Table 5.3-3 shows that rubber degradation is plausible for the CC containment isolation control valves. These containment isolation control valves have a butyl liner that can degrade with aging. [Reference 1, CV02, Attachment 6] The internal environment of the CC System is chemically-treated water at a design pressure of 150 psig and a maximum design temperature of 180°F [Reference 2, Section 9.5.2.1, Table 9-17]

Group 4 (rubber degradation) - Aging Mechanism Effects

Rubber/elastomers may degrade over time due to the combined effects of scission, crosslinking, and changes associated with compound ingredients. Rubber degradation could result in the loss of leak tightness for the valve. Significant degradation is not expected since rubber/elastomer stressors are minimal in the service environments and appropriate rubber/elastomer selection significantly prolongs service life. However, over time the butyl liners may experience some degradation; therefore, rubber degradation has been determined to be a plausible ARDM for which aging effects must be managed for the susceptible CC device types. [Reference 1, CV02, Attachment 6]

Group 4 (rubber degradation) - Methods to Manage Aging

Mitigation: No programs are credited with mitigating degradation of the control valve liners.

Discovery: Because rubber degradation would affect the leak tightness of these containment isolation valves, local leak rate testing (LLRT) of the containment isolation valves can provide detection of leakage that could be the result of rubber liner degradation. Performing LLRT of these valves on a frequency that could ensure that the valves' intended function is not compromised under the CLB for the period of extended operation could reveal any effects of rubber degradation. [Reference 1, Attachment 8]

Group 4 (rubber degradation) - Aging Management Program(s)

Mitigation: Since there are no reasonable methods of mitigating rubber degradation of the control valves' liner surfaces, there are no programs credited with mitigating the aging effects due to this ARDM.

Discovery: Calvert Cliffs procedures STP M-571E-1, M-571E-2, "Local Leak Rate Test, Penetrations 15, 16, 18, 38, 59, 60, 61, 62, 64," are part of the overall CCNPP Containment Leakage Rate Program. The CCNPP Containment Leakage Rate Program was established to implement the leakage testing of the containment as required by 10 CFR 50.54(o) and 10 CFR 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors." Appendix J specifies containment leakage testing requirements, including the types of tests required, frequency of testing, test methods, test pressures, acceptance criteria, and reporting requirements. Containment leakage testing requirements include performance of Integrated Leakage Rate Tests, also known as Type A tests, and LLRTs, also known as Type B and C tests. Type A tests measure the overall leakage rate of the containment. Type B tests are intended to detect leakage paths and measure leakage for certain containment penetrations (e.g., airlocks, flanges, and electrical penetrations). Type C tests are intended to measure containment isolation valve leakage rates. [Reference 7, Section 6.5.6; References 8 and 9]

The CCNPP LLRT program is based on the requirements of CCNPP Technical Specifications 3.6.1.2, 4.6.1.2, and 6.5.6. The scope of the program includes Type B and C testing of containment penetrations. The control valves that isolate the containment penetration piping for the CC System are included in the scope of this program as part of the leakage testing for containment penetrations 16 and 18. [References 7, 10, and 11]

The LLRT is performed at a frequency in accordance with 10 CFR 50, Appendix J, Option B. per References 10 and 11, currently the LLRT includes the following procedural steps:

- Leak rate monitoring test equipment is connected to the appropriate test point.
- Test volume is pressurized to at least 53 (+/- 1) psig above atmospheric pressure. Note, the LLRT program test pressure is conservative with respect to the 10 CFR 50, Appendix J test pressure requirements. Appendix J requires testing at a pressure "P_a" which is the peak calculated containment internal pressure related to the Design Basis accident. For CCNPP, P_a, is 49.4 psig as stated in CCNPP Technical Specification 6.5.6.

- Leak rate, pressure, and temperature are monitored at the frequency specified by the LLRT procedure and the results are recorded.
- The maximum indicated leak rate is compared against administrative limits which are more restrictive than the maximum allowable leakage limits.
- "As found" leakage equal to or greater than the administrative limit but less than the maximum allowable limit is evaluated to determine if further testing is required and/or if corrective maintenance is to be performed.
- For "as found" leakage that exceeds the maximum allowable limit, the Shift Supervisor and the Containment System Engineer are notified and they determine if Technical Specification Limiting Condition for Operation (LCO) 3.6.1.2.b has been exceeded. Technical Specification 3.6.1.2.b contains the maximum allowable combined leakage for all penetrations and valves subject to the Type B and C tests. Corrective action is taken as required to restore the leakage rates to within the appropriate acceptance criteria.
- If any maintenance is required on a penetration boundary that could affect the valves' ability to provide containment integrity, an "as left" test must be performed on the penetration to ensure leakage rates are acceptable.

The corrective actions taken as part of the LLRT program will ensure that the CC System containment isolation control valves remain capable of performing their intended function under all CLB conditions during the period of extended operation.

Group 4 (rubber degradation) - Demonstration of Aging Management

Based on the information presented above, the following conclusions can be reached with respect to CC System containment isolation valve liners subject to rubber degradation:

- The CC System containment isolation control valves provide the containment isolation function and their integrity must be maintained under CLB design conditions.
- Rubber degradation is plausible for the CC System containment isolation control valve liners causing a decrease in leak tightness of the valve seat, which could lead to a loss of containment isolation integrity under CLB conditions.
- The CCNPP LLRT Program performs leakage testing which could detect the effects of rubber degradation on the control valves' liner (i.e., leak tightness), and contains acceptance criteria that ensure corrective actions will be taken such that there is a reasonable assurance that the containment isolation function will be maintained.

Therefore, there is reasonable assurance that the effects of rubber degradation will be managed in order to maintain the pressure boundary function provided by the CC System control valves, consistent with the CLB during the period of extended operation.

Group 5 (selective leaching) - Materials and Environment

Table 5.3-3 shows that selective leaching is plausible for the CC device types listed. The CC System device types susceptible to selective leaching and the material characteristics which are susceptible to this ARDM are listed below: [Reference 1, Attachment 1, and AVV01, CV01/02/05, HV04/05, RV03, SV01 Attachments 4, 5, and 6]

- Automatic vents - cast brass base and shell;
- Control valves - some groups have cast iron bodies, and some have aluminum bronze discs;
- Hand valves - some groups have cast iron valve bodies/bonnets and/or cast iron discs;
- Relief valves - some groups have brass seats and discs; and
- Solenoid valves - are made of brass.

The internal environment of the CC System is chemically-treated water at a design pressure of 150 psig and a maximum design temperature of 180°F. [Reference 2, Section 9.5.2.1, Table 9-17] This CC water is treated with hydrazine to lower the dissolved oxygen level. [Reference 1, Pipe-Attachment 6] Certain regions of the CC System have low or stagnant flow conditions.

Group 5 (selective leaching) - Aging Mechanism Effects

Selective leaching is the removal of one element from a solid alloy by corrosion processes. The most common example is the selective removal of zinc in brass alloys (dezincification). Similar processes occur in other alloy systems in which aluminum, iron, cobalt, chromium and other elements are removed. There are two types of selective leaching, layer-type and plug-type. Layer-type is a uniform attack whereas plug-type is extremely localized leading to pitting. Overall dimensions do not change appreciably. If a piece of equipment is covered by debris or surface deposits and/or not inspected closely, sudden unexpected failure may occur due to the poor strength of the remaining material. Selective leaching requires susceptible materials and a corrosive environment. Conducive environmental conditions include high temperature, stagnant aqueous solution, and porous inorganic scale. Acidic solutions and oxygen may aggravate the mechanism. [Reference 1, Valve Attachment 7]

The device types discussed in the materials and environment section above are susceptible to the ARDM (for the valve body, the liner is not credited with aging management; it is conservatively assumed that the material is in contact with the fluid due to degradation of the rubber liner). The device types are exposed to flow conditions and may be exposed to stagnant conditions. The expected effects of selective leaching are cracking and dezincification. [Reference 1, CV Attachment 6, SV Attachment 6]

Gray cast irons are susceptible to a selective leaching process called "graphitic corrosion." The iron or steel matrix leaches from the material leaving a porous mass consisting of a graphite network, voids and rust. The cast iron loses strength and its metallic properties. [Reference 1, Valve Attachment 7]

Long-term exposure to the chemical environment in the CC System may result in selective leaching and, if unmanaged, could eventually result in loss of the pressure-retaining capability under CLB design loading conditions. Therefore, selective leaching has been determined to be a plausible ARDM for which aging effects must be managed for the CC System.

Group 5 (selective leaching) - Methods to Manage Aging

Mitigation: Maintaining a CC System environment of purified water with controls on pH, suspended solids and chlorides during normal plant operation can mitigate this ARDM. The addition of hydrazine lowers the CC System dissolved oxygen level and mitigates one of the aggravating chemical factors. [Reference 1, Attachments 6 and 8]

Discovery: Inclusion of CC System device types in an inspection program that examines a representative sample of susceptible areas of the system for the signs of selective leaching prior to the period of extended operation could identify whether this ARDM is actually occurring in the CC device types.

Group 5 (selective leaching) - Aging Management Program(s)

Mitigation: The CCNPP CP-206, "Specifications and Surveillance for Component Cooling/Service Water Systems," provides for monitoring of the CC chemistry to control the concentrations of oxygen, chlorides, other chemicals and contaminants. The water is treated with hydrazine to minimize the amount of oxygen in the water which aids in the prevention and control of most corrosive mechanisms. Continued maintenance of system water quality will ensure minimal piping or component degradation. [Reference 1, Attachment 8] Refer to the discussion of CP-206 under Group 1 (crevice corrosion/pitting), Aging Management Programs.

Discovery: The CC System device types listed above will be included in the ARDI Program to verify that degradation of CC device types is not excessive. Refer to the ARDI discussion under Group 1 (crevice corrosion/pitting), Aging Management Programs for more details on this program. [Reference 1]

Group 5 (selective leaching) - Demonstration of Aging Management

Based on the information presented above, the following conclusions can be reached with respect to selective leaching for the CC device types listed here:

- The control valves, hand valves, relief valves and solenoid valves described here act as a pressure-retaining boundary, and their integrity must be maintained under CLB design conditions.
- Selective leaching is plausible for the valve device types discussed in the materials and environment section above, which could lead to the loss of the pressure-retaining boundary function of the CC System.
- The CCNPP CP-206, "Specification and Surveillance CC/SRW Systems," is a program that will mitigate the effects of aging mechanisms on CC System device types by controlling the range of specific chemical parameters and providing action levels for these chemistry parameters.
- The CCNPP ARDI Program will be utilized to discover any selective leaching that may be of concern for the CC System device types. Inspections will be performed, and appropriate corrective action will be taken if selective leaching is discovered.

Therefore, there is a reasonable assurance that the effects of selective leaching will be managed in order to maintain the CC components intended function under all design loading conditions required by the CLB during the period of extended operation.

Group 6 (wear) - Materials and Environment

Table 5.3-3 shows that wear is plausible for the CC device types listed. The CC System device types susceptible to wear and the material characteristics which are susceptible to this ARDM are listed below: [Reference 1, Attachment 1, and CKV 02, CV02, RV01, RV02, RV03, Attachments 4, 5, and 6]

- Check valves - some groups have carbon steel discs;
- Control valves - some groups have butyl valve liners; and
- Relief valves - some groups have stainless steel valve seats and discs, and some have brass valve seats and discs.

The internal environment of the CC System is chemically-treated water at a design pressure of 150 psig and a maximum design temperature of 180°F. [Reference 2, Section 9.5.2.1, Table 9-17] During normal plant operation valves are actuated to move between the closed, intermediate, and full open position. Some valves may remain in the open or closed position for an extended period of time before being actuated to a different position.

Group 6 (wear) - Aging Mechanism Effects

Wear results from relative motion between two surfaces (adhesive wear), from the influence of hard, abrasive particles (abrasive wear) or sliding motions under the influence of a corrosive environment (fretting). In addition to material loss from the above wear mechanisms, impeded relative motion between two surfaces held in intimate contact for extended periods may result in galling/self welding. Motions may be linear, circular, or vibratory in inert or corrosive environments. The most common result of wear is damage to one or both surfaces involved in the contact. Wear most typically occurs in components which experience considerable relative motion such as valves and pumps, in components which are held under high loads with no motion for long periods (valves, flanges), or in clamped joints where relative motion is not intended but occurs due to a loss of clamping force (e.g., tubes in supports, valve stems in seats, springs against tubes). Wear rates may increase as worn surfaces experience higher contact stresses. [Reference 1, Valve, Attachment 7]

The sub-components of the device types are located in the CC fluid flow stream. Movement of the sub-component is expected to occur during changes and variations in flow conditions. Valve discs may periodically relieve pressure and experience movement against the seat. The expected effect of wear is a progressive loss of material from the sub-component. Limited leakage past the check valve discs will not significantly impact intended function. The CC device types listed above are therefore susceptible to this ARDM. [Reference 1, CKV, CV, RV, Attachment 6]

Group 6 (wear) - Methods to Manage Aging

Mitigation: Since the wear of the valves seating surfaces is due to valve operation, decreased use of the valve would slow the degradation of the valve leak tightness. However, this method is not feasible from a plant operations standpoint. Therefore, it is concluded that there are no reasonable methods of mitigating wear of the valves seating surfaces.

Discovery: Wear can be discovered by inspecting and testing the valve device types that are susceptible to this ARDM. Routine bench testing and inspection can identify wear of the relief valve seating surfaces. Inspections are to be performed on representative samples of susceptible areas of the CC System for the signs of wear prior to the period of extended operation. In addition, LLRT of the containment isolation valves can provide detection of leakage that could be the result of wear on valve internals. The frequency of LLRT of these valves is sufficient to ensure that the intended function is not compromised under the CLB for the period of extended operation.

Inclusion of CC System device types in an inspection program that examines a representative sample of susceptible areas of the system for the signs of wear prior to the period of extended operation could identify whether this ARDM is actually occurring on the CC device types.

Group 6 (wear) - Aging Management Program(s)

Mitigation: Since wear cannot be avoided during plant operation, there are no programs credited with mitigating wear.

Discovery: The CCNPP Procedures STP M-571E-1, M-571E-2, "Local Leak Rate Test, Penetrations 15, 16, 18, 38, 59, 60, 61, 62, 64," are part of the overall CCNPP Containment Leakage Rate Program that will be used to monitor the CC containment isolation control valves for leak tightness. The CCNPP Containment Leakage Rate Program was established to implement the leakage testing of the containment as required by 10 CFR 50.54(o) and 10 CFR 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors." Appendix J specifies containment leakage testing requirements, including the types of tests required, frequency of testing, test methods, test pressures, acceptance criteria, and reporting requirements. Containment leakage testing requirements include performance of Integrated Leakage Rate Tests, also known as Type A tests, and LLRTs, also known as Type B and C tests. Type C tests are intended to measure containment isolation valve leakage rates. [Reference 7, Section 6.5.6; References 8 and 9] For further discussion of the LLRT program as it relates to the CC containment isolation control valves, refer to the Group 4 (rubber degradation) section - Aging Management Programs.

The CC check valves will be included in the ARDI Program to verify that wear is not occurring. Refer to the ARDI discussion under Group 1(crevice corrosion/pitting) - Aging Management Programs for more details of the program.

Calvert Cliffs checklists MPM01012, MPM01013, and MPM01143, "Relief Valves," direct the removal, testing, and reinstallation of the satisfactorily tested relief valves. The checklists refer to another procedure for the performance of the relief valve setpoint test, and are performed on a four- to five-year frequency. [References 12, 13, and 14] Routine bench testing will identify wear of the valve seating surfaces. [Reference 1, Attachment 8]

Group 6 (wear)- Demonstration of Aging Management

Based on the information presented above, the following conclusions can be reached with respect to the CC device types subject to wear:

- The CC device types described here act as a pressure-retaining boundary, and their integrity must be maintained under CLB design conditions.
- Wear is plausible for the valve device types discussed in the materials and environment section above which could lead to the loss of the pressure-retaining boundary function of the CC System.
- The CCNPP LLRT Program provides leakage testing which could detect the effects of wear on the CC control valves listed for this ARDM, and contains acceptance criteria that ensure corrective actions will be taken such that there is a reasonable assurance that the pressure boundary function will be maintained.
- The CCNPP ARDI Program will be utilized to discover any wear that may be of concern for the CC System check valves. Inspections will be performed, and appropriate corrective action will be taken if significant wear is discovered.
- The CCNPP MPM01012, MPM01013, and MPM01143 Checklists direct the removal, relief setpoint testing, and reinstallation of CC System relief valves. Routine bench testing will identify wear of the valve seating surface.

Therefore, there is a reasonable assurance that the effects of wear will be managed in order to maintain the CC device types' intended function under all design loading conditions required by the CLB during the period of extended operation.

5.3.3 Conclusion

The aging management programs discussed for the CC System are listed in Table 5.3-4. These programs are administratively controlled by a formal review and approval process. As demonstrated above, these programs will manage the aging mechanisms and their effects such that the intended functions of the CC System components will be maintained during the period of extended operation consistent with the CLB under all design loading conditions.

The analysis/assessment, corrective action, and confirmation/documentation process for license renewal is in accordance with QL-2, " Corrective Actions Program." Procedure QL-2 is pursuant to 10 CFR Part 50, Appendix B, and covers all structures and components subject to AMR.

TABLE 5.3-4

LIST OF AGING MANAGEMENT PROGRAMS FOR THE COMPONENT COOLING SYSTEM

	Program	Credited For
Existing	CCNPP "Specifications and Surveillance for CC/SRW Systems," CP-206	Mitigation of the effects of crevice corrosion/pitting (Group 1), general corrosion (Group 3), and selective leaching (Group 5) of CC System components.
Existing	CCNPP "Component Cooling Pump Overhaul and Inspection," PUMP-14	Discovery and management of crevice corrosion/pitting (Group 1) and general corrosion (Group 3) of the CC pumps through inspection and overhaul. These activities are performed as required based on pump performance trends or corrective action requirements.
Existing	LLRTs, STP M-571E-1 and M-571E-2	Discovery of leakage that could be the result of rubber liner degradation (Group 4) or wear (Group 6) of the CC System containment isolation control valve internals.
Existing	CCNPP Preventive Maintenance Checklists MPM01012, MPM01013, MPM01143	Discovery and management of wear (Group 6) of the CC System relief valves. They are performed on a four- to five-year interval to remove and test CC System relief valves.
New	ARDI Program	Discovery and management of the effects of crevice corrosion/pitting (Group 1), erosion corrosion (Group 2), general corrosion (Group 3), selective leaching (Group 5), and wear (Group 6) for CC System components. The results from implementation of the ARDI Program are to be used to determine actions required to ensure that the affected components continue to support the identified passive intended functions throughout the period of extended operation.

5.3. References

1. CCNPP "Component Cooling System Aging Management Review," Revision 2, June 29, 1997
2. CCNPP, Updated Final Safety Analysis Report, Revision 19
3. CCNPP Technical Procedure Component Level ITLR Screening Results, Component Cooling System, Revision 1, August 15, 1996
4. CCNPP CP-206, "Specifications and Surveillance Component Cooling/Service Water System," Revision 3, November 4, 1996
5. CCNPP PUMP-14, "Component Cooling Pump Overhaul," Revision 1, February 4, 1997
6. CCNPP Engineering Standard ES-014, "Summary of Ambient Environmental Service Conditions," Revision 0, November 8, 1995
7. Letter from Mr. A. W. Dromerick (NRC) to Mr. C. H. Cruse (BGE), "Issuance of Amendments for Calvert Cliffs Nuclear Power Plant, Unit 1(TAC No. M92549) and Unit 2 (TAC No. M92550)," dated October 18, 1996 [Amendment Nos. 217/194]
8. 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors."
9. Letter from Mr. R. E. Denton (BGE) to NRC Document Control Desk, dated January 16, 1996, "License Amendment Request: Adoption of 10 CFR Part 50, Appendix J, Option B for Type A Testing"
10. CCNPP Surveillance Test Procedure STP-M-571E-1, "Local Leak Rate Test, Penetrations 15, 16, 18, 38, 59, 60, 61, 62, 64" (Unit 1), Revision 0, May 17, 1991
11. CCNPP Surveillance Test Procedure STP-M-571E-2, "Local Leak Rate Test, Penetrations 15, 16, 18, 38, 59, 60, 61, 62, 64" (Unit 2), Revision 0, October 17, 1991
12. CCNPP MPM01012 Checklist Sheet, "Remove Relief Valves," Revision 0, January 27, 1992
13. CCNPP MPM01013 Checklist Sheet, "Remove Relief Valves," Revision 0, January 28, 1992
14. CCNPP MPM01143 Checklist Sheet, "Remove Relief Valves," Revision 0, December 24, 1991

ATTACHMENT (2)

APPENDIX A - TECHNICAL INFORMATION

5.4 - COMPRESSED AIR SYSTEM

5.4 Compressed Air System

This is a section of the Baltimore Gas and Electric Company (BGE) License Renewal Application (LRA) addressing the Compressed Air System. The Compressed Air System was evaluated in accordance with the Calvert Cliffs Nuclear Power Plant (CCNPP) Integrated Plant Assessment (IPA) Methodology described in Section 2.0 of the BGE LRA. These sections are prepared independently and will, collectively, comprise the entire BGE LRA.

5.4.1 Scoping

System level scoping describes conceptual boundaries for plant systems and structures, develops screening tools which capture the 10 CFR 54.4(a) scoping criteria, and then applies the tools to identify systems and structures within the scope of license renewal. Component level scoping describes the components within the boundaries of those systems and structures that contribute to the intended functions. Scoping to determine components subject to aging management review (AMR) begins with a listing of passive intended functions and then dispositions the device types as either only associated with active functions, subject to replacement, or subject to AMR either in this report or another report.

Section 5.4.1.1 presents the results of the system level scoping, 5.4.1.2 the results of the component level scoping, and 5.4.1.3 the results of scoping to determine components subject to an AMR.

Representative historical operating experience pertinent to aging is included in appropriate areas to provide insight supporting the aging management demonstrations. This operating experience was obtained through key-word searches of BGE's electronic database of information on the CCNPP dockets and through documented discussions with currently assigned cognizant CCNPP personnel.

5.4.1.1 System Level Scoping

This section begins with a description of the system which includes the boundaries of the system as it was scoped. The intended functions of the system are listed and are used to define what portions of the system are within the scope of license renewal.

System Description/Conceptual Boundaries

The Compressed Air System consists of an Instrument Air (IA), Plant Air (PA), and Saltwater Air Subsystem for each unit. The IA Subsystem is designed to provide a reliable supply of dry and oil-free air for the pneumatic instruments and controls and pneumatically-operated containment isolation valves. The PA Subsystem is designed to meet necessary service air requirements for plant maintenance and operation. The Saltwater Air Subsystem provides a backup supply of compressed air to most safety-related (SR) components. [Reference 1, Sections 9.10.2 and 9.10.5]

The IA Subsystem incorporates two non-safety-related (NSR), full-capacity, oil-free compressors, each having a separate inlet filter, aftercooler and moisture separator. The IA compressors discharge to a single header which is connected to two air receivers. Both air receivers discharge to a compressed air outlet header which supplies IA to the air dryers and filter assembly. The compressed air header then divides into branch lines supplying compressed air to the pretreatment and tank storage area, the intake structure, the service building, the water treatment area, the Turbine Building, the Containment Structure, and the Auxiliary Building. [Reference 1, Section 9.10.2]

An emergency back-up tie from the PA header automatically supplies air to the IA Subsystem if the pressure at the instrument filter and dryer assembly falls below a set value. The PA service header isolation valves also shut if the pressure falls below a set value so the PA compressors discharge only to the IA Subsystem. [Reference 1, Section 9.10.2; References 2 and 3]

The PA Subsystem consists of one NSR, full-capacity PA compressor with an inlet filter, aftercooler, and moisture separator which discharges to the PA receiver. The receiver outlet header is connected to the prefilter assembly, which is followed by an outlet header. The outlet header branches into two separate air headers, one that supplies the IA dryers and filter assembly through a cross connect that is normally isolated, and the other that supplies the PA Subsystem loads: the pretreatment and storage tank area; the intake structure; the service building; the water treatment area; the Turbine Building, The Containment Structure; and the Auxiliary Building. A system cross-tie between Unit 1 and Unit 2 PA Subsystems has been provided for the PA headers. [Reference 1, Section 9.10.2]

A continuous supply of IA is provided to hold various pneumatically-operated valve actuators in the positions necessary for plant operating conditions. Under normal plant operating conditions, one IA compressor operates and the second IA compressor is on automatic standby. [Reference 1, Section 9.10.4] The PA Subsystem is normally cross-connected between units, with one PA compressor operating and supplying both units' loads, and the other compressor in standby. The power supply for the compressors is the normal distribution system and can be backed up by the diesel generators. Accumulators are located at various locations throughout the plant and act as system reservoirs and also reduce system pressure pulsations. [Reference 4, Section 1.1.2]

In the event that IA and PA compressors become unavailable, such as following load shedding due to a safety injection actuation signal, two SR saltwater air compressors will provide a backup supply of compressed air to most SR components. These compressors are automatically started upon receipt of a safety injection actuation signal and can also be operated from a local panel. The saltwater air compressors supply the saltwater air header which distributes air to all saltwater isolation valves for the service water heat exchangers, component cooling heat exchangers, and the Emergency Core Cooling System pump room air coolers. The saltwater air header also supplies compressed air to the auxiliary feedwater control valves, containment air-operated control valves, atmospheric dump valves, reactor coolant sample isolation valves, and service water containment air cooler valves. [References 1, 5, 6, 7, 8, 9, 10, and 11]

System Interfaces

The Compressed Air System has an interface with the Service Water System which provides cooling water to the IA and PA air compressors and aftercoolers. The Service Water System is within the scope of license renewal and is addressed in Section 5.17 of the BGE LRA. The Compressed Air System also has interfaces with the many systems which have components being supplied with compressed air. Any local air set or accumulator associated with a specific load is typically included within the boundaries of the system being supplied.

System Scoping Results

The Compressed Air System is within the scope of license renewal based on 10 CFR 54.4(a). The following intended functions of the Compressed Air System were determined based on the requirements of §54.4(a)(1) and (2), in accordance with the CCNPP IPA Methodology, Section 4.1.1: [Reference 12, Table 1]

- Provide a vital auxiliary air supply, via Saltwater Air Subsystem, for components used to mitigate Design Basis Events.
- Provide a vital auxiliary air supply, via Auxiliary Feedwater Air Subsystem, for components used to mitigate Design Basis Events.
- Provide a vital auxiliary air supply, via Containment Air Subsystem, for components used to mitigate Design Basis Events.
- Provide a load shed indication.
- Provide Containment Isolation during a Design Basis Event.
- Maintain the pressure boundary of the system (liquid and/or gas).
- Maintain electrical continuity and/or provide protection of the electrical system.
- Provide seismic integrity and/or protection of SR components.

The following Compressed Air System intended functions were determined based on the requirements of §54.4(a)(3): [Reference 12, Table 1]

- For fire protection (§50.48) - Provide control air to essential loads to ensure safe shutdown in the event of a postulated severe fire.
- For environmental qualification (§50.49) - Maintain functionality of electrical equipment as addressed by the Environmental Qualification Program, and provide information used to assess the plant and environs condition during and following an accident.

All components of the Compressed Air System that meet the environmental qualification criteria of 54.4(a)(3) are also SR. Some of the components which meet the fire protection criteria (§50.48) are NSR, and are in the scope of license renewal only because of the 54.4(a)(3) criteria.

All components of the Compressed Air System that support the above functions, with the exception of the fire protection function, are SR and Seismic Category 1 and are subject to the applicable loading conditions identified in the UFSAR Section 5A.3.2 for Seismic Category 1 systems and equipment design. Portions of the system required for fire protection are NSR and non-seismic. [References 1, 13, and 14]

The compressed air piping is designed in accordance with ANSI B31.1, Power Piping Code, with the exception of the containment penetration piping sections. The IA and PA containment penetration piping is designed to Class II of ANSI B31.7, Nuclear Power Piping Code. The piping is considered Non-Class piping for the purposes of the American Society of Mechanical Engineers (ASME) Section XI Inservice Inspection Program, with the exception of the containment penetration piping sections. The IA containment penetration piping section is considered Class MC for inservice inspection. The PA containment penetration piping has both Class MC and Non-Class designations. [References 5, 6, 7, 8, 9, 15, 16, and 17]

Operating Experience

In 1988, the NRC and the Institute of Nuclear Power Operations (INPO) notified utilities of concerns regarding failures of plant IA systems. NRC's Generic Letter 88-14 required each licensee to perform a design and operational verification of the IA system. Institute of Nuclear Power Operations' Significant Operating Experience Report 88-1 included a number of recommendations related to operations, training, maintenance, and design/analysis of IA systems. Baltimore Gas and Electric Company initiated a number of actions, including testing of air-operated valves and dampers supplied by SR accumulators, in response to these notices. A review of the Compressed Air System, including a root cause analysis, identified inadequacies in design, maintenance, and testing practices. Due to corrective actions resulting from this review, the Compressed Air System has undergone significant improvements in the areas of design, maintenance, operations, and testing. [References 18, 19, 20, 21, and 22]

Since these improvements, the Compressed Air System equipment has been well maintained and the air quality is periodically tested and maintained in accordance with standard ISA-S-7.3, "Quality Standard for Instrument Air." Operating experience has shown that the air normally provided is very dry and contains little particulate matter. Dewpoint temperature, which is indicative of moisture content, is typically less than -40°F at 100 psig, which is well below the requirement; i.e., at least 18°F below the minimum local recorded ambient temperature at the plant site. Particulate sampling shows a relatively normal distribution of particle sizes for a filtered Compressed Air System. The little amount of particulate measured which exceeds specific component maximum particulate requirements is captured in local filters at those components. No trace of oil or hydrocarbons has been detected, so oil content is no longer routinely monitored. The normal supply of air is from the IA compressors which are of oil-free design. [Reference 23]

5.4.1.2 Component Level Scoping

Based on the intended system functions listed above, the portion of the Compressed Air System that is within the scope of license renewal includes all SR components in the system (electrical, mechanical, and instrument), and their supports. Safety related portions of the Compressed Air System include those that support the intended functions listed above in System Scoping Results for meeting the requirements of §54.4(a)(1) and (2), and the environmental qualification (§50.49) intended function under the requirements of §54.4(a)(3). [Reference 12, Table 1; Reference 13]

Also within the scope of license renewal are certain NSR portions of the Compressed Air System required for fire protection (§50.48) under the requirements of §54.4(a)(3). Included are those portions of the system that supply air to components required to achieve safe shutdown in the event of a severe fire, as required by 10 CFR Part 50 Appendix R. Each of the Compressed Air System air compressors, i.e., IA, PA and saltwater air compressors, support the fire protection intended function because they are relied on in postulated fire scenarios. Essential safe shutdown loads, which may be supplied with compressed air from either SR or NSR portions of the system in the event of a fire, include service water valves, main steam isolation valves, emergency diesel generators, saltwater valves, component cooling valves, safety injection valves, and containment spray valves. However, as discussed below, all of the

NSR portions of the Compressed Air System subject to AMR are evaluated in the Fire Protection AMR presented in Section 5.10 of the BGE LRA. [References 13 and 14]

The following 27 device types in the Compressed Air System were designated as within the scope of license renewal because they have at least 1 intended function [Reference 4, Section 3.2 and Table 3-2]:

- Air Accumulator
- Air Compressor
- Check Valve
- Coil
- Compressed Air System Piping
- Control Valve
- Drain Trap
- Filter
- Fuse
- Handswitch
- Hand Valve
- Level Switch
- Motor (SR saltwater air compressors)
- Motor (NSR IA and PA air compressors)
- Motor-Operated Valve (MOV)
- Panel
- Position Indicating Lamp
- Position Switch
- Power Lamp Indicator
- Pressure Control Valves (PCVs)
- Pressure Indicator
- Pressure Switch
- Pump (air amplifier)
- Relay
- Relief Valve
- Solenoid Valve
- Temperature Switch

Some components in the Compressed Air System are common to many other plant systems and have been included in separate commodity AMRs which address those components for the entire plant. These components include the following: [Reference 4, Section 3.2]

- Structural supports for piping, cables, and components are evaluated for the effects of aging in the Component Supports Commodity Evaluation in Section 3.1 of the BGE LRA.
- Electrical instrumentation, control, and power cabling are evaluated for the effects of aging in the Electrical Cables Commodity Evaluation in Section 6.1 of the BGE LRA. This commodity evaluation completely addresses the passive intended function entitled "maintain electrical continuity and/or provide protection of the electrical system" for the Compressed Air System.
- Instrument tubing and piping and the associated supports, instrument valves, and fittings (generally everything from the outlet of the final root valve up to and including the instrument), and the pressure boundaries of the instruments themselves, are all evaluated for the effects of aging in the Instrument Lines Commodity Evaluation in Section 6.4 of the BGE LRA.
- All tubing and many PCVs, regulating valves, and reducing valves do not have unique equipment identifiers in the CCNPP Master Equipment List. These valves are evaluated for the effects of aging in the Instrument Lines Commodity Evaluation in Section 6.4 of the BGE LRA.

5.4.1.3 Components Subject to AMR

This section describes the components within the Compressed Air System which are subject to AMR. It begins with a listing of passive intended functions and then dispositions the device types as either only associated with active functions, subject to replacement, evaluated in other reports, evaluated in commodity reports, or remaining to be evaluated for aging management in this section.

Passive Intended Functions

In accordance with CCNPP IPA Methodology Section 5.1, the following Compressed Air System functions were determined to be passive. [Reference 4, Table 3-1]

- Maintain the pressure boundary of the system.
- Maintain electrical continuity and/or provide protection of the electrical system.
- Provide seismic integrity and/or protection of SR components.

The Compressed Air System has an additional function associated with fire protection. Both SR and NSR components support the fire protection function of providing control air to essential loads to ensure safe shutdown in the event of a postulated severe fire. Only the SR Compressed Air System components, as defined in the CCNPP Engineering Standard for Functional Safety Classifications, Reference 13, are further evaluated in this section. In accordance with the CCNPP IPA Methodology, NSR portions of the Compressed Air System, which are within the scope of license renewal only for their fire protection functions, are evaluated in the fire protection commodity evaluation described in Section 5.10 of the BGE LRA. [Reference 14]

Device Types Subject to AMR

Of the 27 device types within the scope of license renewal: [Reference 4, Table 3-2; References 14 and 24]

- Nine device types have only active functions and do not require AMR; Coil, Fuse, Hand Switch, Motor (SR saltwater air compressors), Motor (NSR IA and PA compressors), Position Indicating Lamp, Position Switch, Power Lamp Indicator, and Relay.
- One device type is comprised of components subject to a replacement program, i.e., environmental qualification program, and does not require AMR; Solenoid Valve.
- Three devices types are evaluated in another section of the BGE LRA.

  Panel is evaluated for the effects of aging in the Electrical Panels Commodity Evaluation in Section 6.2 of the BGE LRA. This commodity evaluation completely addresses the passive intended function entitled "provide seismic integrity and/or protection of SR components."

  Pressure Indicator and Pressure Switch are evaluated for the effects of aging in the Instrument Lines Commodity Evaluation in Section 6.4 of the BGE LRA.
- Four device types do not require AMR because of specific exclusion by the license renewal rule, i.e., all components included with the skid-mounted saltwater air compressors; Air Compressor (including associated accumulator), Drain Trap, Level Switch, and Temperature Switch.

The remaining ten device types listed in Table 5.4-1 are subject to AMR and are included in this section. Maintenance of the pressure boundary of the system is the only passive intended function associated with the Compressed Air System that is not addressed by one of the commodity evaluations referred to above. Therefore, only the pressure retaining function for the ten device types listed in Table 5.4-1 is considered in the AMR for the Compressed Air System. Unless otherwise annotated, all components of each listed device type are subject to AMR.

TABLE 5.4-1
COMPRESSED AIR SYSTEM DEVICE TYPES REQUIRING AMR

Air Accumulator (1)
Compressed Air System Piping (3)
Check Valve
Control Valve
Filter
Hand Valve(2)
MOV
PCV (1 and 4)
Pump (air amplifier)
Relief Valve (1)

(1) Excludes SR components that are integral to the skid-mounted saltwater air compressors.

(2) Instrument line manual drain, equalization, and isolation valves in the Compressed Air System that are subject to AMR are evaluated for the effects of aging in the Instrument Lines Commodity Evaluation in Section 6.4 of the BGE LRA. Instrument line manual root valves are evaluated in this report. [Reference 24, Attachment 3]

(3) All tubing and tubing supports are included in the Instrument Lines Commodity Evaluation in Section 6.4 of the BGE LRA.

(4) Many PCVs, regulating valves, or reducing valves do not have unique equipment identifiers in the CCNPP Master Equipment List. These valves are included in the Instrument Lines Commodity Evaluation in Section 6.4 of the BGE LRA.

5.4.2 Aging Management

A list of potential age-related degradation mechanisms (ARDMs) identified for the Compressed Air System components is given in Table 5.4-2. [Reference 4, Table 4-2] The plausible ARDMs are identified in the Table by a check mark (✓) in the appropriate device type column. For AMR, some device types have a number of groups associated with them because of the diversity of material used in their fabrication or differences in the environments to which they are subjected. A check mark indicates that the ARDM applies to at least one group for the device type listed. For efficiency in presenting the results of the evaluations in this section, ARDM/device type combinations are grouped together where there are similar characteristics and the discussion is applicable to all components within that group. Exceptions are noted in the discussions, where appropriate. Table 5.4-2 identifies the group in which each ARDM/device type combination belongs. The following groups have been selected for the Compressed Air System.

Group 1 - Includes wear for all check valves and MOVs subject to AMR.

Group 2 - Includes general corrosion for all of the components subject to AMR except for the pump (air amplifier).

TABLE 5.4-2

POTENTIAL AND PLAUSIBLE ARDMs FOR THE COMPRESSED AIR SYSTEM

Potential ARDMs	Compressed Air System Device Types									
	HB	ACC	CKV	PUMP(a)	CV	FL	HV	MOV	PCV	RV
Fatigue										
Fouling										
General Corrosion	✓(2)	✓(2)	✓(2)		✓(2)	✓(2)	✓(2)	✓(2)	✓(2)	✓(2)
Hydrogen Damage										
Radiation Damage										
Rubber Degradation										
Wear			✓(1)					✓(1)		

✓ - Indicates that the ARDM is plausible for component(s) within the Device Type
(#) - Indicates the Group in which this ARDM/device type combination is evaluated
(a) - Air amplifier

Device Types					
HB	=	Compressed Air, System Piping	FL	=	Filter
ACC	=	Air Accumulator	HV	=	Hand Valve
CKV	=	Check Valve	MOV	=	Motor-Operated Valve
PUMP	=	Pump	PCV	=	Pressure Control Valves
CV	=	Control Valve	RV	=	Relief Valve

Note: Not every group within the device types listed here may be susceptible to a given ARDM. This is because groups within a device type are not always fabricated from the same materials or subjected to the same environments. Exceptions for each device type will be indicated in the aging management section for each ARDM discussed in this report.

Note: Fouling of Compressed Air System components is inconsequential because of existing air quality requirements that are maintained by system air dryers and filters. If fouling were to occur, it would affect an active function, which would be detectable during plant operation and corrected through on-going maintenance program activities.

The following is a discussion of the aging management demonstration process for each group identified above. It is presented by group and includes a discussion of materials and environment, aging mechanism effects, methods to manage aging, aging management program(s), and aging management demonstration.

Group 1 (wear for check valves and MOVs) - Materials and Environment

The Compressed Air System check valves, for which wear is considered a plausible degradation mechanism, include one valve per unit which forms part of the containment isolation pressure boundary. Also included are four valves per unit that form a SR-to-NSR pressure boundary for portions of the system. Each of those valves must close in order to maintain the required pressure boundary. Other Compressed Air System check valves are not relied on to shut in order to maintain the intended functions. The subject check valves are divided into sub-components of body/bonnet and disk/seat. The body/bonnet are constructed from carbon steel and the disk/seat from either carbon steel or stainless steel. [Reference 4, Attachment 4, Attachment 5 for Check Valves, and Attachment 8]

The Compressed Air System MOVs serve as containment isolation pressure boundary and are divided into the subcomponents of body/bonnet and internals. The body/bonnet are constructed from carbon steel and the internals are constructed from alloy steel. [Reference 4, Attachment 4 for MOVs, and Attachment 8]

The internal environment for the Compressed Air System components is normally compressed air supplied by the IA compressors. The IA is very dry, filtered, and oil-free air. Particle size, dew point, and oil hydrocarbons are controlled for the IA supply in accordance with standard ISA-S-7.3, "Quality Standard for Instrument Air." The dew point, which is a measurement of air moisture content, is normally maintained at -40°F at 100 psig. This dew point is well below the air quality standard of at least 18°F below the minimum local recorded ambient temperature at the plant site. [References 1 and 23]

Occasionally, air from either the PA or saltwater air compressors may enter the system. That is because the PA or saltwater air compressors can be used as a backup to the IA compressors if they become unavailable. Additionally, the saltwater air compressors are run for brief periods of time each month for testing. [References 5, 6, 8, 9, and 25] If the PA or saltwater air compressors are used to supply the IA Subsystem, the return to use of the IA compressors as the supply of compressed air will rapidly return the air quality to the normally dry state. This is due to the very dry air supplied by the IA compressors, and because the continuous air demand continuously purges the IA Subsystem lines.

The PA Subsystem air compressors use a filter-silencer which removes particulates in the air. The PA compressor discharges to an aftercooler and moisture separator which removes moisture in the air. Furthermore, the PA Subsystem utilizes a prefilter between the receivers and the headers. This prefilter removes oil and moisture from the air to prevent contamination of the Compressed Air System components and loads. The saltwater air compressors are designed to prevent oil or oil vapor from being compressed with the air. An aftercooler cools the compressed air and condenses moisture, which passes to the receiver where it is drained by an automatic valve. Based on the design and limited operation of these backup systems, perturbations in air quality outside of accepted industry air quality standards (dry, filtered, and oil-free) will be limited. [References 5, 6, 8, and 9]

Group 1 (wear for check valves and MOVs) - Aging Mechanism Effects

Wear results from relative motion between two surfaces (adhesive wear), from the influence of hard, abrasive particles (abrasive wear) or fluid stream (erosion); and from small, vibratory or sliding motions under the influence of a corrosive environment (fretting). Motions may be linear, circular, or vibratory in inert or corrosive environments. In addition to material loss from the above wear mechanisms, impeded relative motion between two surfaces held in intimate contact for extended periods may result in galling/self welding. Wear rates may accelerate as expanded clearances result in higher contact stresses. [Reference 4, Attachment 7 for Valves]

The disk/seat of check valves subject to wear are required to close to maintain containment pressure boundary integrity or system pressure boundary integrity. Wear of other Compressed Air System check valves was not considered because these components are not required to close to maintain intended functions and are, therefore, not subject to AMR. [Reference 4, Attachment 4s and 5s for Check Valves]

Wear is considered plausible for the disk/seat of check valves and MOVs because they may experience cyclic relative motion at the tight fitting surfaces. Movement of the disk against the seat can result in a gradual loss of material, which could result in a small amount of leakage. If left unmanaged, wear could eventually lead to a loss of pressure boundary integrity. [Reference 4, Attachment 4s, 5s, and 6s] Calvert Cliffs has experienced some wear of check valves with several valves failing back-leakage tests, including those performed in response to Generic Letter 88-14. However the root cause of these failures is due to a combination of wear and the valve being inappropriately chosen for its intended application. [Reference 23]

Group 1 (wear for check valves and MOVs) - Methods to Manage Aging Effects

Mitigation: Since the wear of check valve disk/seats and MOV internals are due to valve operation, decreased operation of the valves would slow the degradation of the valves seating surfaces. This mitigation technique is not feasible, however. The discovery methods discussed below are deemed adequate for mitigating wear of check valve disk/seats and MOV internals. It should be noted that galling/self-welding occur when there is impacted relative motion between two surfaces held in intimate contact for extended periods. Periodic valve operation actually minimizes this phenomenon.

Discovery: Wear for check valve disks/seats and MOV internals can be detected by performing leak rate testing. Since wear occurs gradually over time, periodic testing can be used to discover minor leakage so that corrective actions can be taken prior to the loss of an intended function. [Reference 4, Attachment 6s for Check Valves and MOVs]

Group 1 (wear for check valves and MOVs) - Aging Management Program(s)

Mitigation: There are no feasible methods of mitigating wear of the check valve disk/seat and MOV internals; therefore, there are no programs credited with mitigating the aging effects due to this ARDM.

Discovery: The check valves and MOVs performing the containment isolation function are subject to local leak rate testing under the CCNPP Containment Leakage Rate Program, as required by 10 CFR Part 50, Appendix J. [Reference 4, Attachment 6 for Check Valves and MOVs] The check valves providing a SR-NSR pressure boundary for portions of the system are subject to leak rate testing under the CCNPP Pump and Valve Inservice Testing (IST) Program. This valve testing was voluntarily added to the IST Program that is used to meet the requirements of 10 CFR 50.55a(f). Both programs are implemented in accordance with the plant Technical Specifications. [References 26; 27; 28, Section 1; and Reference 29]

Operating experience relative to the IST on IA check valves and MOVs includes isolated cases of unacceptable leakage. Some of these experiences were identified in testing implemented in response to NRC and industry concerns regarding check valves in general. The root cause of these problems has been attributed to a combination of wear, small amounts of debris, and the valve being inappropriately chosen for its intended application. No widespread problems associated with wear of the check valves or MOVs have been identified. [References 18 and 22]

CCNPP Containment Leakage Rate Testing Program

The local leak rate test (LLRT) is performed under Surveillance Test Procedures M-571F-1 and M-571F-2 as part of the overall CCNPP Containment Leakage Rate Testing Program. The CCNPP Containment Leakage Rate Testing Program was established to implement the leakage testing of the containment, as required by 10 CFR 50.54(o) and 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors - Option B." Appendix J specifies containment leakage testing requirements, including the types of tests required, frequency of testing, test methods, test pressures, acceptance criteria, and reporting requirements. Containment leakage testing requirements include performance of Integrated Leakage Rate Tests, also known as Type A tests, and LLRTs, also known as Type B and C tests. Type A tests measure the overall leakage rate of the containment. Type B tests are intended to detect leakage paths and measure leakage for certain containment penetrations (e.g., airlocks, flanges, and electrical penetrations). Type C tests are intended to measure containment isolation valve leakage rates. [Reference 26, Section 6.5.6; References 30 and Reference 31]

The CCNPP Containment Leakage Rate Testing Program is based on 10 CFR Part 50, Appendix J, Option B, requirements and implements the requirements in CCNPP Technical Specifications 3.6.1.2, 4.6.1.2, and 6.5.6. The scope of the program includes Type B and C testing of containment penetrations [References 26, 27, and 28] Per References 27 and 28, currently the LLRT includes the following procedural steps:

- Leak rate monitoring test equipment is connected to the appropriate test point.
- Test volume is pressurized to at least 53 ± 1 psig above atmospheric pressure, which is conservative with respect to the 10 CFR Part 50, Appendix J, test pressure requirements.
- Leak rate, pressure, and temperature are monitored at the frequency specified by the LLRT procedure and the results are recorded.
- The maximum indicated leak rate is compared against administrative limits, which are more restrictive than the maximum allowable leakage limits.
- "As found" leakage equal to or greater than the administrative limit, but less than the maximum allowable limit, is evaluated to determine if further testing is required and/or if corrective maintenance is to be performed.
- For "as found" leakage that exceeds the maximum allowable limit, the Shift Supervisor and the Containment System Engineer are notified, and they determine if Technical Specification Limiting Condition for Operation (LCO) 3.6.1.2.b has been exceeded. Technical

Specification 3.6.1.2.b contains the maximum allowable combined leakage for all penetrations and valves subject to the Type B and C tests. Corrective action is taken as required to restore the leakage rates to within the appropriate acceptance criteria.

- If any maintenance is required on a penetration boundary that would affect the valves' ability to perform their closure function, an "as left" test must be performed on the penetration to ensure leakage rates are acceptable.

The corrective actions taken as part of the Containment Leakage Rate Testing Program will ensure that the containment isolation check valves and MOVs remain capable of performing their containment pressure boundary integrity function under all CLB conditions.

CCNPP Pump and Valve IST Program

The leak rate testing of the check valves providing SR-NSR pressure boundary portions of the system is performed by Surveillance Test Procedures M-583-1 and M-583-2 as part of the overall CCNPP Pump and Valve IST Program. The Pump and Valve IST Program was established to implement IST in accordance with Section XI of the ASME Boiler and Pressure Vessel Code, as required by 10 CFR 50.55a(f). American Society of Mechanical Engineers XI, Subsection IWV, directs each licensee to comply with the applicable portions of ASME/ANSI OM-10. American Society of Mechanical Engineers/ANSI OM-10 provides the rules and requirements for IST of CCNPP valves, including the types of tests required, frequency of testing, test methods, test pressures, acceptance criteria, and reporting requirements. In addition to the general Code requirements discussed above, there are additional interpretations and positions that have come about as a result of past regulatory and licensee actions, including NUREG-1482, Guidelines for Inservice Testing at Nuclear Power Plants. [References 29, 32, 33, 34, and 35]

Testing is implemented by CCNPP Technical Specification 4.0.5. The subject Group 1 check valves were voluntarily added to the IST program as part of the Augmented Testing Program for Non-Code Class Pumps and Valves, and are tested in accordance with ASME/ANSI OM-1987, including Oma-1988 Addenda. The subject check valves are required to be verified shut after a full-stroke closure every refueling outage in accordance with the Pump and Valve IST Program Third Ten-Year Interval. This verification is accomplished through leakage tests performed by Surveillance Test Procedures M-583-1 and M-583-2. [References 29 and 35]

Per References 33 and 34, the test includes the following procedural steps:

- Leak rate monitoring test equipment is connected to the appropriate test point.
- The upstream side is slowly depressurized to seat the valve. If slow depressurization does not seat the valve, then rapid depressurization is used.
- The leak rate is measured and recorded.
- The measured leak rate is compared against acceptance criteria for the valve.
- If measured leakage is less than or equal to the acceptance criteria the valve is satisfactory. If not, the System Engineer reviews the data and determines if corrective actions are required in accordance with the CCNPP Corrective Action Program.

- The "as left" measured leakage for the subject valve is added to the "as left" measured leakage for the other Compressed Air System valves tested in this procedure. The total leakage is compared against the maximum allowable leakage for the system.
- If the total leakage exceeds the maximum allowable leakage, the System Engineer is notified. The System Engineer determines if corrective action is required in accordance with the CCNPP Corrective Action Program.

The test procedure requires a comparison of measured valve leakage against permissible leakage rates for individual valves, based on valve size, as specified in ASME Section IWV-3426(b). This leakage criteria was also used as the assumed leakage when determining the maximum load on the SR air compressors. The test procedure also requires a comparison of total measured system leakage against the maximum allowable leakage rate. The maximum allowable leakage rate is established by Design Engineering. [References 33 and 34]

The corrective actions taken as part of the Pump and Valve IST Program will ensure that the check valve providing SR-NSR pressure boundary for the containment air portion of the system will remain capable of performing the system pressure boundary integrity function under all CLB conditions.

Group 1 (wear for check valves and MOVs) - Demonstration of Aging Management

Based on the information presented above, the following conclusions can be reached with respect to wear of check valves and MOVs for the Compressed Air System.

- The check valve disks/seats and MOV internals maintain containment pressure boundary or system SR-NSR pressure boundary and their integrity must be maintained under all CLB conditions.
- Wear is plausible for check valve disks/seats and MOV internals and results in material loss which, if left unmanaged, could eventually lead to leakage and loss of pressure boundary.
- The containment isolation valves are subject to local leak rate testing in accordance with the CCNPP Containment Leakage Rate Program.
- The check valves providing a SR-NSR pressure boundary function are subject to leak rate testing in accordance with the CCNPP Pump and Valve IST Program.
- Leak testing will continue to be performed by these programs in accordance with the plant Technical Specifications, and appropriate corrective actions will be taken if significant wear is discovered.

Therefore, there is reasonable assurance that the effects of wear for Compressed Air System check valves and MOVs will be managed in such a way as to maintain the components' pressure boundary integrity, consistent with the CLB, during the period of extended operation.

Group 2 (general corrosion for all device types except pumps) - Materials and Environment

General corrosion is considered plausible for components in the Compressed Air System that are constructed of carbon steel because of the potential exposure to slightly moist air. The Compressed Air System piping was evaluated for general corrosion as a whole because the entire sections of pipe, including fittings, flanges, and bolting, have the pressure boundary function and they are generally made of carbon steel. Piping above two inches is Schedule 40 carbon steel with buttwelded fittings. Piping two inches and below is Schedule 80 carbon steel with socket-welded fittings. Threaded connections are allowed on certain portions of the piping by the design specification. [Reference 4, Attachment 6; Reference 17]

The Group 2 device types were evaluated for general corrosion on a subcomponent basis. Each subcomponent was evaluated to determine whether it was required to maintain the pressure boundary of the system and was, therefore, subject to AMR. The materials of construction for each of the subcomponents subject to AMR were then evaluated. General corrosion is considered plausible for only those pressure retaining subcomponents which are constructed of carbon steel. Each device type has at least one subcomponent that is potentially susceptible to general corrosion. [Reference 4, Attachment 4s and Attachment 6s]

The internal environment for the Compressed Air System components is normally air supplied by the IA compressors. The air quality is discussed in Materials and Environment for Group 1.

Group 2 (general corrosion for all device types except pumps) - Aging Mechanism Effects

General corrosion is the thinning (wastage) of a metal by chemical attack (dissolution) at the surface of the metal by an aggressive environment. General corrosion requires an aggressive environment and materials susceptible to that environment. Carbon steels are subject to corrosion, i.e., rusting, due to exposure to water and the presence of oxygen. General corrosion is not plausible for Compressed Air System subcomponents constructed of alloy steel, stainless steel, brass, or aluminum because these materials are resistant to general corrosion in their operating environments. [Reference 4, Attachment 7s]

The ARDM is plausible in the Compressed Air System because the carbon steel materials of construction may occasionally be exposed to slightly moist air. The expected effects would be superficial rust speckles and a slight dusting of loose passive surface rust. The consequences of general corrosion damage to the affected component is a loss of load carrying cross-sectional area. However, general corrosion is not expected to reach the point where it affects the intended function of components in the Compressed Air System. [Reference 4, Attachment 6s and Attachment 8] An additional concern for the Compressed Air System results from the byproduct of corrosion, namely rust particles. Accumulation of rust particles around the diaphragm mechanism of the PCVs or the disk/seat of control valves and MOVs can contribute to wear. The wear aging mechanism is discussed above in Group 1.

Group 2 (general corrosion for all device types except pumps) - Methods to Manage Aging

Mitigation: The IA Subsystem air quality is normally maintained in accordance with industry standards for moisture (dewpoint) and particulate concentrations. Continued maintenance of IA Subsystem air quality to industry standards will ensure minimal component degradation resulting from moisture or from rust particles. The use of air dryers and filters maintains the air quality within acceptable limits. In order to assure that the compressed air quality remains within acceptable limits, the air quality should be periodically checked and compared against the industry standards. [Reference 4, Attachment 8] If testing shows a reduction in air quality, corrective actions can be initiated to return the air quality to normal.

The possibility of occasional exposure to slight moisture exists from operation of the saltwater air compressors because there is no dryer for this supply. The exposure to moisture is minimal and short term, and is not expected to result in significant levels of degradation of the carbon steel components. An inspection performed on the piping immediately downstream of the saltwater air compressors, where the worst case of general corrosion is expected, revealed only very light surface rust on the inside of each piece. After more than 20 years in operation, approximately 60% of the pipe interior contained no rust and appeared similar to the inside of new pipe. Thickness measurements showed that the wall thickness averaged only 0.001 inch less than the nominal thickness of 0.179 inch. [Reference 4, Attachment 8] Since air in the IA and Saltwater Air Subsystems is normally very dry and there is so little corrosion evident after more than 20 years of operation, continued maintenance of the air quality is deemed an adequate aging management technique for general corrosion control in these subsystems.

Discovery: Although the PA Subsystem is designed to minimize the amount of particulates, moisture, and oil content in the air as described above in Materials and Environment, the PA Subsystem is not maintained to any specific air quality standards, and it does not contain any air dryers. Therefore, the carbon steel containment penetration components may be occasionally exposed to moist air. However, it is not expected to result in significant degradation or rapid attack of the carbon steel components because these lines are in use only during plant outages. Pressure testing for valve leakage would result in detection of minor degradation of the valve seating surfaces due to general corrosion. A visual inspection of the PA containment penetration piping and valves would assure that significant degradation is not occurring to the remaining internal surfaces of the piping and valves. [Reference 4, Attachment 8]

Group 2 (general corrosion for all device types except pumps) - Aging Management Program(s)

Mitigation:

CCNPP Preventive Maintenance Program

The CCNPP Preventive Maintenance Program has been established to maintain plant equipment, structures, systems, and components in a reliable condition for normal operation and emergency use, minimize equipment failure, and extend equipment and plant life. The program covers all preventive maintenance activities for nuclear power plant structures and equipment within the plant, including the Compressed Air System components within the scope of license renewal. [Reference 36] It is based on INPO documents, References 37, 38 and 39.

Calvert Cliffs initiated a Preventive Maintenance Task following a review of recommendations in Significant Operating Experience Report (SOER) 88-01. This task checks the IA Subsystem air quality at three locations in the system; at the dryer outlet, at the furthest point from the dryer, and at the approximate mid-point between the other two. Measurements of dew point and particulate count are taken every 12 weeks at these locations. This Preventive Maintenance Task is automatically scheduled and implemented in accordance with SR Preventive Maintenance Program procedures. [References 36 and 40]

According to procedure, dew point data and particulate sample results are provided to the System Engineer who is responsible for reviewing and evaluating the data in accordance with SOER 88-01. Significant Operating Experience Report 88-01 recommends maintaining the air quality within the requirements of standard ISA-S-7.3, "Quality Standard for Instrument Air." Standard ISA-S7.3 recommends limits for maximum particle size, dew point temperature, and oil content. The System Engineer determines if the air quality is abnormal, and initiates corrective action to return the air quality to normal and to investigate the condition of the dependent load internals, as appropriate. [References 19 and 40]

The Preventive Maintenance Program has been evaluated by the NRC during Plant Performance Reviews which serve as inputs to the NRC Systematic Assessment of Licensee Performance and senior management meeting reviews. [Reference 41] The plant Maintenance Program itself has numerous levels of management review, all the way down to the specific implementation procedures. For example, the Principal Engineer - Reliability Engineering Unit and Principal Engineer - Maintenance/Component Engineering both have specific responsibilities for evaluating and upgrading the Preventive Maintenance Program. The System Engineer and System Manager have specific responsibilities for initiating changes to the Preventive Maintenance Program based on results of the tests. These controls provide reasonable assurance that the Preventive Maintenance Program will continue to be an effective method of mitigating the effects of general corrosion on the Compressed Air System components. [Reference 36]

Operating experience relative to air quality control of the IA Subsystem has shown that the air normally provided is very dry and contains little particulate matter. The air is supplied by oil-free compressors. Dewpoint results are typically less than -40°F at 100 psig, which is well below the requirement; i.e., at least 18°F below the minimum local recorded ambient temperature at the plant site. Particulate sampling shows a relatively normal distribution of particle sizes for a filtered Compressed Air System. The little amount of particulate measured which exceed specific component maximum particulate requirements is captured in local filters at those components. No trace of oil or hydrocarbons has been detected, so oil content is no longer routinely monitored. The normal supply of air is from the IA compressors which are of oil-free design. [Reference 23]

Discovery: Continued implementation of the mitigation technique discussed above should ensure that exposure of the IA Subsystem carbon steel components to moisture will continue to be minimal. Since the Saltwater Air Subsystem is only installed as a backup to the IA Subsystem essential loads, introduction of moisture from this subsystem will also be minimal. Corrosion of these components is not expected to result in significant levels of degradation. It is deemed that the mitigation techniques described above are adequate aging management practices for general corrosion, and no discovery techniques are necessary for the IA and Saltwater Air Subsystems.

Since the PA Subsystem is not maintained to any specific air quality standards, the carbon steel containment penetration components may be occasionally exposed to moist air. The containment penetration portion of the PA Subsystem will therefore be included in a new program to accomplish the needed inspections for general corrosion. The new program will be considered an ARDI Program as defined in the CCNPP IPA Methodology presented in Section 2.0 of the BGE LRA.

The elements of the ARDI Program will include:

- Determination of the examination sample size based on plausible aging effects;
- Identification of the inspection locations in the system/component based on plausible aging effects and consequences of loss of component intended function;
- Determination of examination techniques (including acceptance criteria) that would be effective, considering the aging effects for which the component is examined;
- Methods for interpretation of examination results;
- Methods for resolution of unacceptable examination findings, including consideration of all design loadings required by the current licensing basis (CLB), and specification of required corrective actions; and
- Evaluation of the need for follow-up examinations to monitor the progression of any age-related degradation.

In addition to the ARDI Program, the PA Subsystem containment isolation valves will be subject to periodic testing. These valves are subject to local leak rate testing under the Surveillance Test Procedures M-571F-1 and M-571F-2 in accordance with 10 CFR Part 50 Appendix J. [Reference 4, Attachment 8; References 26, 27, and 28, Section 1.0] Pressure testing for valve leakage will result in detection of minor degradation of the valves' seating surfaces due to corrosion. Continued local leak rate testing on a periodic basis will assure acceptable leak tightness of these valves and will also ensure that any leakage remains within the guidelines of the Technical Specifications.

The LLRT is part of the overall CCNPP Containment Leakage Rate Testing Program. This program is discussed in detail above for Group 1. The corrective actions taken as part of the Containment Leakage Rate Testing Program and ARDI Program will ensure that the containment isolation portion of the PA Subsystem remains capable of performing the containment pressure boundary integrity function under all CLB conditions.

Group 2 (general corrosion for all device types except pumps) - Demonstration of Aging Management

Based on the factors presented above, the following conclusions can be reached with respect to general corrosion of Compressed Air System components:

- The Compressed Air System components provide the system pressure-retaining boundary and their integrity must be maintained under CLB design conditions.
- General corrosion is plausible for the carbon steel components and results in material loss which, if left unmanaged, can lead to loss of pressure-retaining boundary integrity.

- The rate of attack is affected by the amount of moisture in the air because the moisture could condense on Compressed Air System carbon steel components.
- The dew point temperature, which is indicative of air moisture content, is maintained low in the IA Subsystem and is periodically measured and tracked in accordance with the Preventive Maintenance Program. If the air quality becomes abnormal, corrective actions are initiated to return the air quality to normal and to investigate the condition of the dependent load internals, as appropriate.
- Since the PA Subsystem is not maintained to any specific air quality standards, the containment isolation portion of this subsystem will be included in the scope of an ARDI Program. Inspections will be performed and appropriate corrective action will be taken if significant corrosion is discovered.
- To provide assurance that general corrosion of valve seating surfaces is not threatening the containment boundary for the PA Subsystem, this portion will also be periodically leak tested in accordance with the Containment Leakage Rate Testing Program. The Containment Leakage Rate Testing Program includes requirements for corrective actions if the leak rates become unacceptable.

Therefore, there is reasonable assurance that the effects of general corrosion on Compressed Air System components will be managed in such a way as to maintain the components' pressure boundary integrity, consistent with the CLB, during the period of extended operation.

5.4.3 Conclusion

The programs discussed for the Compressed Air System are listed in Table 5.4-3. These programs are (and will be for new programs) administratively controlled by a formal review and approval process. As has been demonstrated in the above section, these programs will manage the aging mechanisms and their effects such that the intended functions of the components of the Compressed Air System will be maintained, consistent with the CLB, during the period of extended operation.

The analysis/assessment, corrective action, and confirmation/documentation process for license renewal is in accordance with QL-2, "Corrective Actions Program." QL-2 is pursuant to 10 CFR Part 50, Appendix B, and covers all structures and components subject to AMR.

Table 5.4-3
LIST OF AGING MANAGEMENT PROGRAMS FOR THE COMPRESSED AIR SYSTEM

	Program	Credited As
Existing	CCNPP Pump and Valve IST Program Surveillance Test Procedures M-583-1 and M-583-2	• Discovery and management of the effects of seating surface wear of the check valves that provide SR-NSR pressure boundary for portions of the Compressed Air System (Group 1)
Existing	CCNPP Local Leak Rate Test Program: Unit 1 Procedure STP-M-571F-1, "Local Leak Rate Test, Penetrations 19A (Inst Service) 19B (Service Air)" Unit 2 Procedure STP-M-571F-2, "Local Leak Rate Test, Penetrations 19A (IA), 19B (PA)"	• Discovery and management of leakage that could be the result of seating surface wear of the check valves and MOVs that provide IA Subsystem containment pressure boundary (Group 1) • Discovery and management of leakage that could be the result of general corrosion of the valves' seating surfaces that provide PA Subsystem containment pressure boundary (Group 2)
Existing	CCNPP Maintenance Program Procedure MN-1-102, "Preventive Maintenance Program" Preventive Maintenance Repetitive Tasks 10191024 and 20191022	• Mitigation of the effects of general corrosion of the Compressed Air System carbon steel components (Group 2)
New	ARDI Program	• Discovery and management of the effects of general corrosion of the containment penetration portion of the PA Subsystem carbon steel components (Group 2)

5.4.4 References

1. "CCNPP Updated Final Safety Analysis Report," Revision 20
2. CCNPP Drawing No. 61082SH0004, "Schematic Diagram Plant and Instrument Air Control Valves 1-CV-2059 and 1-CV-2061," Revision 6, January 3, 1989
3. CCNPP Drawing No. 63082SH0004, "Schematic Diagram Plant and Instrument Air Control Valves 2-CV-2059 and 2-CV-2061," Revision 7, December 5, 1988
4. "CCNPP Compressed Air System AMR Report," Revision 4, June 25, 1997
5. CCNPP Drawing No. 60712SH0001, "Compressed Air System, Instrument Air and Plant Air," Revision 46, December 5, 1996
6. CCNPP Drawing No. 60712SH0003, "Compressed Air System, Instrument Air and Plant Air," Revision 75, August 2, 1996
7. CCNPP Drawing No. 60712SH0005, "Compressed Air System, Instrument Air and Plant Air," Revision 46, November 11, 1996
8. CCNPP Drawing No. 62712SH0001, "Compressed Air System, Instrument Air and Plant Air," Revision 37, July 24, 1996
9. CCNPP Drawing No. 62712SH0003, "Compressed Air System, Instrument Air and Plant Air," Revision 80, February 19, 1997
10. CCNPP Drawing No. 60746SH0002, "Plant Water and Air System Service," Revision 23, November 1, 1996
11. CCNPP Drawing No. 61076SH0046, "Schematic Diagram Reactor Safeguards Saltwater System Air Compressors 11 and 12," Revision 9, August 12, 1993
12. "Component Level Screening Results for the Compressed Air System, System No. 019, CCNPP," Revision 3, December 20, 1996
13. CCNPP Engineering Standard ES-011, "System, Structure, and Component (SSC) Evaluation," Revision 4, August 27, 1996
14. "CCNPP Fire Protection AMR Report," Revision 1, January 29, 1997
15. CCNPP Drawing No. 63076SH0046, "Schematic Diagram Reactor Safeguards Saltwater System Air Compressors 11 and 12," Revision 7, December 13, 1993
16. CCNPP Drawing No. 92769SH-HB-4, "M-601 Piping Class Summary," Revision 23, July 31, 1996
17. CCNPP Drawing No. 92767SH-HB-1, "M-600 Piping Class Sheets," Revision 57, July 31, 1996
18. Letter from Mr. G. C. Creel (BGE) to NRC Document Control Desk, dated February 17, 1989, "Response to NRC Generic Letter 88-14, Instrument Air Supply Problems Affecting Safety-Related Equipment"
19. INPO SOER 88-01, "Instrument Air System Failures," May 18, 1988

20. NRC Generic Letter 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment," August 8, 1988

21. Letter from Mr. D. G. McDonald, Jr. (NRC) to Mr. G. C. Creel (BGE), dated April 18, 1990, "Response to Generic Letter 88-14, Instrument Air Supply System Problems Affecting Safety Related Systems - Calvert Cliffs Nuclear Power Plant, Units 1 and 2"

22. Letter from Mr. R. E. Denton (BGE) to NRC Document Control Desk, Licensee Event Report 89-018-01, "Failure of SR Air Accumulators to Perform as Required Results in a Condition that Could Have Prevented Certain Systems from Performing Their Intended Safety Functions," April 6, 1990

23. Letter from Mr. G. C. Creel (BGE) to NRC Document Control Desk, dated May 25, 1989, "Response to Request for Additional Information Generic Letter 88-14, Instrument Air Supply System Problems Affecting Safety-Related Equipment"

24. CCNPP "Pre-Evaluation Results for the Compressed Air System (#019)," Revision 6, November 30, 1995

25. CCNPP Operations Performance Evaluation Requirement Nos. 1-12-3-O-M and 2-12-3-O-M, "Run Saltwater Air Compressors," Revision 2, February 4, 1997

26. Letter from Mr. A. W. Dromerick (NRC) to Mr. C. H. Cruse (BGE), "Issuance of Amendments for Calvert Cliffs Nuclear Power Plant, Unit 1(TAC No. M92549) and Unit 2 (TAC No. M92550)," dated October 18, 1996 [Amendment Nos. 217/194]

27. CCNPP Surveillance Test Procedure STP-M-571F-1, "Local Leak Rate Test, Penetrations 19A (Inst Service), 19B (Service Air)" (Unit 1), Revision 0, May 17, 1991

28. CCNPP Surveillance Test Procedure STP-M-571F-2, "Local Leak Rate Test, Penetrations 19A (Instrument Air), 19B (Plant Air)" (Unit 2), Revision 0, October 17, 1991

29. CCNPP Administrative Procedure EN-4-102, "ASME Pump and Valve Testing," Revision 1, September 18, 1996

30. 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors"

31. Letter from Mr. R. E. Denton (BGE) to NRC Document Control Desk, dated January 16, 1996, "License Amendment Request: Adoption of 10 CFR Part 50, Appendix J, Option B for Type A Testing"

32. CCNPP Administrative Procedure EN-4-104, "Surveillance Testing," Revision 1, October 23, 1996

33. CCNPP Technical Procedure Unit 1 STP M-583-1, "Instrument Air Safety Related Pressure Boundary Check Valve Leak Test," Revision 0, April 4, 1996

34. CCNPP Technical Procedure Unit 2 STP M-583-2, "Instrument Air Safety Related Pressure Boundary Check Valve Leak Test," Revision 0, April 4, 1996

35. "CCNPP Pump and Valve Inservice Testing Program Third Ten-Year Interval," April 30, 1997

36. CCNPP Administrative Procedure MN-1-102, "Preventive Maintenance Program," Revision 5, September 27, 1996

37. INPO 85-032, "Preventive Maintenance," December 1988

38. INPO 85-037, "Reliable Power Station Operation," October 1985

39. INPO Good Practice MA-319, "Preventive Maintenance Program Enhancement," December 1992

40. Repetitive Tasks 10191024 and 20191022, "Check Instrument Air Quality at System Low Points," Preventative Maintenance Program

41. Letter from Mr. R. W. Cooper, II (NRC) to Mr. C. H. Cruse (BGE), dated May 31, 1996, "Calvert Cliff's Plant Performance Review Results"