VERIFICATION OF VYNPS LICENSE RENEWAL PROJECT REPORT

Title of Report: **Aging Management Review of the Reactor Building Closed Cooling Water System**

Report Number: **AMRM-12**

Revision: **0**

This report documents evaluations related to the VYNPS license renewal project. Signatures certify that the report was prepared, checked and reviewed by the License Renewal Project Team in accordance with the VYNPS license renewal project guidelines and that it was approved by the ENI License Renewal Project Manager and the VYNPS Manager, Engineering Projects.

License Renewal Project Team signatures also certify that a review for determining potential impact to other license renewal documents, based on previous revisions, was conducted for this revision.

Other document(s) impacted by this revision: _____Yes, See Attachment __X__No

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REVISION DESCRIPTION SHEET

Revision Number	Description	Pages and/or Sections Revised
0	Initial Issue	

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1.0 Introduction

1.1 Purpose

This report is part of the aging management review (AMR) of the integrated plant assessment (IPA) performed to extend the operating license of Vermont Yankee Nuclear Power Station (VYNPS). This report demonstrates the effects of aging on reactor building closed cooling water (RBCCW) system passive mechanical components will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis as required by 10 CFR 54.21(a)(3). For additional information on the license renewal project and associated documentation, refer to the License Renewal Project Plan.

The purpose of this report is to demonstrate that aging effects for passive mechanical components will be adequately managed for the period of extended operation associated with license renewal. The approach for demonstrating management of aging effects is to first identify the components that are subject to aging management review in Section 2.0. The next step is to define the aging effects requiring management for the system components in Section 3.0. Section 4.0 then evaluates if existing programs and commitments adequately manage those effects.

Applicable aging effects were determined using EPRI report 1003056 *Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools* **(Ref. 1)**. This EPRI report provides the bases for identification of aging effects based on specific materials and environments and documents confirmation of the validity of the aging effects through review of industry experience. This aging management review report (AMRR), in conjunction with EPRI report 1003056, documents the identification and evaluation of aging effects requiring management for mechanical components in the RBCCW system.

1.2 System Description

As described in UFSAR Section 10.9, the RBCCW system consists of a closed cooling loop containing two 100% capacity pumps and two 100% capacity heat exchangers. Service water cools the RBCCW system. Differential expansion is accommodated by a surge tank on the suction side of the pumps. Makeup to the surge tank is automatically provided from the demineralized water system. RBCCW heat exchanger discharge is divided into four parallel cooling loops. One loop provides cooling water to equipment within primary containment. Primary containment isolation is achieved with a check valve on the inlet to primary containment, a motor-operated valve on the outlet from primary containment, and closed loop piping inside containment. The second loop provides cooling water to reactor water clean-up system nonregenerative heat exchangers, clean-up system pump coolers, sample coolers and fuel pool heat exchangers. The third loop provides cooling water to residual heat removal (RHR) pump seal coolers, radwaste building holding pump coolers, control rod drive pump coolers and fuel pool demineralizer air compressor heat exchanger. This loop can also be served by the alternate cooling system by manual repositioning of valves. The fourth loop provides cooling for the primary containment air compressor. **(Ref. 2, 3)**

The system is normally in operation during all modes of operation. **(Ref. 2, 16)**

For additional description of the system and its components, see the RBCCW system design basis document. **(Ref. 3)**

1.3 System and Component Intended Functions

As described in UFSAR Section 10.9.3, RBCCW has a safety function to provide primary containment isolation. RBCCW components that perform this function are the isolation valves outside primary containment and the entire loop inside primary containment. RBCCW has a safety function to provide the capability to cool RHR pump seals during an alternate cooling scenario. RBCCW components that perform this function are the piping and valves between the alternate cooling supply and return and the valves that isolate the rest of the system. **(Ref. 2, 3, 4)**

RBCCW has a function to provide pressure boundary for the service water system via the RBCCW heat exchanger tubes. Components that perform this function are the RBCCW heat exchanger tubes. **(Ref. 2, 4)**

Since VYNPS is a hot safe-shutdown plant, RBCCW does not perform a safety-related heat transfer function. Therefore, the remaining RBCCW components do not support a system level safety function and are not subject to aging management review. **(Ref. 2, 3, 4, 13)**

Use of the alternate cooling system (ACS) for RHR pump seal cooling is credited in the Appendix R evaluation. Therefore RBCCW system piping that supports seal cooling by ACS performs a function that demonstrates compliance with the Commission's regulations for fire protection (10CFR50.48). **(Ref. 6)**

RBCCW system passive mechanical components are not relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for anticipated transients without scram (10CFR50.62), environmental qualification (10CFR50.49), pressurized thermal shock (10CFR50.61 – not applicable for BWRs), or station blackout (10CFR50.63). **(Ref. 3, 5, 7)**

For license renewal, the primary intended function of the RBCCW system components and piping is to maintain system pressure boundary integrity. For additional information on system and component functions, see the RBCCW system design basis document **(Ref. 3)**.

System components outside of the safety class boundary of the RBCCW system whose failure could prevent satisfactory accomplishment of safety functions [10 CFR 54.4(a)(2)] that are not reviewed in this AMRR are reviewed in AMRM-30, Aging Management Review of Nonsafety-related Systems and Components Affecting Safety-related Systems. For VYNPS this includes items such as piping, valves, pumps, and support elements outside of the safety class pressure boundary, that are required to be structurally sound in order to maintain the integrity of the safety class piping.

Refer to VYNPS Report LRPD-01, System and Structure Scoping Results, for additional information on scoping of systems and structures for license renewal.

2.0 Screening

Passive, long-lived components that perform a license renewal component intended function are subject to aging management review. Bolting, flow switch housings, heat exchangers, thermowells, piping, and valve bodies in the RBCCW system are passive, long-lived components.

Components included in this AMRR are the RBCCW primary containment isolation valves and the loop inside primary containment, including the drywell atmospheric cooling units, the drywell equipment drain sump cooling coil, recirculation pump seal water coolers, and coolers on the recirculation pump motors. Jacket water heat exchangers integral to the recirculation pump covers are reviewed in AMRM-33, Aging Management Review of the Reactor Coolant System Pressure Boundary. RBCCW piping to and from the recirculation pump jacket water heat exchangers is reviewed in this AMRR.

This AMRR also includes the piping and components between the alternate cooling supply and return and the valves that isolate the rest of the RBCCW system from the alternate cooling system. The RHR pump coolers are reviewed in report AMRM-02, Aging Management Review of the Residual Heat Removal System.

The RBCCW heat exchanger tubes perform a pressure boundary function for the service water system and are therefore reviewed in AMRM-11, Aging Management Review of the Service Water Systems.

Insulation is installed on some equipment in the RBCCW system. For the evaluation of insulation, refer to LRPD-01, System and Structure Scoping Results, and AMRC-06, Aging Management Review of Bulk Commodities.

A list of the RBCCW system passive mechanical components subject to aging management review is included as Attachment 1. The flow diagrams associated with this system, highlighted to identify components requiring aging management review, are available as drawings LRA-191159 Sh. 1, 2, 3 and 5.

3.0 Aging Effects Requiring Management

EPRI report 1003056 is used in this section to identify and evaluate aging effects requiring management. Aging effects that may result in loss of intended functions for non-Class 1 mechanical components are cracking (i.e., crack initiation, crack growth, and through-wall cracking), change in material properties, loss of material, and fouling. For additional information on aging effects, refer to EPRI report 1003056. **(Ref. 1)**

Attachment 1 is a list of RBCCW system components that form the system pressure boundary or provide structural support. These components require aging management review in this AMRR and are highlighted on the associated LRA drawings.

Portions of the system are located in the primary containment where normal temperature is ≤ 165°F. Components in this system are in the reactor building where normal temperature is approximately 100°F. During normal operation of the RBCCW system, heat exchanger inlet temperature is controlled at ≤ 100°F, ensuring that the 100°F outlet temperature specified in UFSAR Section 10.9.5 is not exceeded. **(Ref. 2, 16)**

Since the primary containment is inerted with nitrogen during power operation, RBCCW components in the primary containment are exposed to nitrogen during power operation. However, when the primary containment atmosphere is de-inerted, the components are exposed to indoor air. Since moisture and other contaminants are more likely to be entrained in air than in nitrogen, the aging effects for materials exposed to indoor air are evaluated.

The following sections document the determination of aging effects requiring management for specific component materials and environments.

3.1 Carbon Steel Components Exposed to Treated Water on Internal Surfaces and Indoor Air on External Surfaces

The system piping components and valves are carbon steel (pipe code CS-1). Inline flow switch housings and thermowells are carbon steel. See Attachment 1 for a list of the carbon steel components. These components are exposed to low temperature treated water on internal surfaces and indoor air on external surfaces. **(Ref. 10, 12, 18, 20)**

Loss of material due to microbiologically influenced corrosion (MIC) and general, pitting and crevice corrosion is an aging effect requiring management for carbon steel surfaces exposed to treated water. Localized galvanic corrosion is also possible at interfaces between carbon steel and dissimilar metals. Loss of material from erosion is possible at high velocity locations and is therefore an aging effect requiring management for carbon steel surfaces.

Cracking due to thermal fatigue is not an aging effect requiring management since system temperature remains below the 220°F threshold for carbon steel thermal fatigue.

Loss of material from general corrosion is considered an aging effect requiring management for carbon steel external surfaces exposed to indoor air.

3.2 Stainless Steel Components Exposed to Treated Water on Internal Surfaces and Indoor Air on External Surfaces

Thermowells in RBCCW lines to the recirculation pumps and motors are stainless steel. See Attachment 1 for a list of the stainless steel components. These components are exposed to treated water on internal surfaces and indoor air on external surfaces. **(Ref. 19)**

Stainless steel is inherently resistant to general corrosion and erosion. Stainless steel internal surfaces are susceptible to loss of material due to MIC, pitting and crevice corrosion in the presence of high oxygen levels and contaminants. Therefore, loss of material is an aging effect requiring management for internal wetted surfaces.

Cracking due to stress corrosion and intergranular attack is not an aging effect requiring management since system temperature remains below the 140°F threshold for these mechanisms in stainless steel.

Cracking due to thermal fatigue is not an aging effect requiring management since system temperature remains below the 270°F threshold for stainless steel thermal fatigue.

There are no aging effects requiring management for external stainless steel surfaces due to the inherent resistance of stainless steel to aging effects when not wetted or exposed to aggressive chemicals.

3.3 Drywell Atmospheric Cooling Units (RRU-1 through RRU-4)

The drywell atmospheric cooling units have copper alloy cooling coils. RBCCW flows through the coils to cool the air inside the drywell. Therefore, the external environment for the tubes is condensation. Since the carbon steel housing provides support for the cooling coils it is included in the review even though pressure boundary of the housing is not required. The housing has drains to prevent accumulation of condensation on internals. Therefore, internal and external surfaces of the housing are exposed to indoor air. **(Ref. 10, 17, 22)**

See Attachment 1 for a list of heat exchanger components and materials.

Copper Alloy Tubes >15% Zn: Treated Water in the Tubes and Air in the Housing

General corrosion of copper alloy tube surfaces is not expected due to the corrosion resistance of this material. However, treated water and condensation can cause pitting corrosion, crevice corrosion, and MIC on tube surfaces. Erosion is a concern in areas of high velocity. Copper alloy > 15% Zn that is not inhibited may also experience selective leaching in treated water. Therefore, loss of material due to pitting corrosion, crevice corrosion, MIC, erosion, and selective leaching is an aging effect requiring management for copper alloy internal tube surfaces.

Loss of material due to wear is an aging effect requiring management for external surfaces of heat exchanger tubes due to possible contact with other components of the heat exchanger. Loss of material due to pitting corrosion, crevice corrosion, and MIC is also an aging effect requiring management for copper alloy external tube surfaces.

Cracking due to stress corrosion and intergranular attack is not an aging effect requiring management for copper alloy since an ammonia environment is not present.

Cracking due to thermal fatigue is not an aging effect requiring management since system temperature remains low. During normal operation of the RBCCW system, system temperature is controlled at ≤ 100°F. Inside the drywell, air temperature is maintained between 135 and 165°F. **(Ref. 2, 16)**

Fouling is not an aging effect requiring management for surfaces of the tubes since heat transfer is not a license renewal component intended function for these heat exchangers.

Carbon Steel Housings: Indoor Air on Internal and External Surfaces

Loss of material due general corrosion is an aging effect requiring management for carbon steel housing internal surfaces exposed to indoor air. Loss of material from erosion or flow-accelerated corrosion is not a concern since the housing internal surfaces are not exposed to high flow rates or fluids with particulates.

Cracking due to thermal fatigue is not an aging effect requiring management since system temperature remains below the 220°F threshold for carbon steel thermal fatigue.

Loss of material from general corrosion is an aging effect requiring management for carbon steel housing external surfaces exposed to indoor air.

3.4 Drywell Equipment Drain Cooler (E-ESC-1A)

The drywell equipment drain cooler is a carbon steel tube heat exchanger. RBCCW flows through the carbon steel tubes to cool the water in the drywell equipment sump. Since the drywell equipment sump may contain drainage from components with untreated water, the external environment for the tubes is untreated water. **(Ref. 10, 14)**

See Attachment 1 for a list of heat exchanger components and materials.

Loss of material due to MIC and general, pitting and crevice corrosion is an aging effect requiring management for carbon steel tube surfaces exposed to treated or untreated water. Localized galvanic corrosion is also possible at interfaces between carbon steel and dissimilar metal components.

Loss of material due to wear is an aging effect requiring management for external surfaces of heat exchanger tubes due to possible contact with other components of the heat exchanger.

Cracking due to thermal fatigue is not an aging effect requiring management since system temperature remains below the 220°F threshold for carbon steel thermal fatigue.

Fouling is not an aging effect requiring management for surfaces of the tubes since heat transfer is not a license renewal component intended function for these heat exchangers.

3.5 Recirculation Pump Seal Water Coolers

The recirculation pump seal water coolers are shell and tube heat exchangers. RBCCW flows through the stainless steel tubes to cool the reactor coolant water inside the shell. Therefore, the internal and external environment for the tubes is treated water. Since the intended function of the coolers is to preserve RBCCW pressure boundary to support the containment isolation system function, the shells of the coolers are not subject to aging management review. **(Ref. 10, 11, 21)**

See Attachment 1 for a list of heat exchanger components and materials.

Stainless steel is inherently resistant to general corrosion and erosion. Stainless steel tube surfaces are susceptible to loss of material due to MIC, pitting and crevice corrosion in the presence of high oxygen levels and contaminants. Therefore, loss of material is an aging effect requiring management for internal and external wetted stainless steel tube surfaces.

Loss of material due to wear is an aging effect requiring management for external surfaces of heat exchanger tubes due to possible contact with other components of the heat exchanger.

Cracking due to stress corrosion and intergranular attack is an aging effect requiring management since the temperature may exceed the 140°F threshold for these mechanisms in stainless steel.

Cracking due to thermal fatigue is not an aging effect requiring management since system temperature remains below the 270°F threshold for stainless steel. **(Ref. 21)**

Fouling is not an aging effect requiring management for surfaces of the tubes since heat transfer is not a license renewal component intended function for these heat exchangers.

3.6 Recirculation Pump Motor Air Coolers

The recirculation pump motor air coolers are stainless steel tube heat exchangers. RBCCW flows through the stainless steel tubes to cool the air inside the motor housing. Therefore, the external environment is indoor air. **(Ref. 10, 15, 11)**

See Attachment 1 for a list of heat exchanger components and materials.

Stainless steel is inherently resistant to general corrosion and erosion. Stainless steel tube surfaces are susceptible to loss of material due to MIC, pitting and crevice corrosion in the presence of high oxygen levels and contaminants. Therefore, loss of material is an aging effect requiring management for internal wetted stainless steel tube surfaces.

Loss of material due to wear is an aging effect requiring management for external surfaces of heat exchanger tubes due to possible contact with other components of the heat exchanger. There are no other aging effects requiring management for external stainless steel surfaces due to the inherent resistance of stainless steel to aging effects when not wetted or exposed to aggressive chemicals.

Cracking due to stress corrosion and intergranular attack is an aging effect requiring management since the temperature may exceed the 140°F threshold for these mechanisms in stainless steel.

Cracking due to thermal fatigue is not an aging effect requiring management since system temperature remains below the 270°F threshold for stainless steel.

Fouling is not an aging effect requiring management for surfaces of the tubes since heat transfer is not a license renewal component intended function for these heat exchangers.

3.7 Recirculation Pump Motor Upper and Lower Bearing Oil Coolers

The recirculation pump motor upper and lower bearing oil coolers are copper alloy tube heat exchangers. RBCCW flows through the copper alloy tubes to cool the bearing oil. The external environment is oil. **(Ref. 10, 15)**

See Attachment 1 for a list of heat exchanger components and materials.

General corrosion of copper alloy tube surfaces is not expected due to the corrosion resistance of this material. However, treated water and oil can cause pitting corrosion, crevice corrosion, and MIC on the tube surfaces. Erosion is a concern in areas of high velocity. Copper alloy > 15% Zn that is not inhibited may experience selective leaching in treated water and oil. Therefore, loss of material due to pitting corrosion, crevice corrosion, MIC, erosion, and selective leaching is an aging effect requiring management for internal copper alloy tube surfaces. Since oil viscosity prevents high velocities, loss of material due erosion is not an aging effect requiring management for the tube surfaces exposed to oil. Loss of material due to pitting corrosion, crevice corrosion, MIC, and selective leaching is an aging effect requiring management for external copper alloy tube surfaces.

Loss of material due to wear is an aging effect requiring management for external surfaces of heat exchanger tubes due to possible contact with other components of the heat exchanger.

Cracking due to stress corrosion and intergranular attack is not an aging effect requiring management for copper alloy since an ammonia environment is not present.

Cracking due to thermal fatigue is not an aging effect requiring management since system temperature remains low. During normal operation of the RBCCW system, system temperature is controlled at ≤ 100°F. Recirculating pump motor design is for maximum bearing temperature of 194°F and maximum cooling water temperature of 105°F. **(Ref. 15, 16)**

Fouling is not an aging effect requiring management for surfaces of the tubes since heat transfer is not a license renewal component intended function for these heat exchangers.

3.8 Bolting

Pressure retaining bolting in this system may be carbon steel or stainless steel and is exposed to indoor air.

Loss of material from general corrosion is considered an aging effect requiring management for carbon steel bolting exposed to indoor air. Loss of material is not an aging effect requiring management for stainless steel bolting that is not wetted.

3.9 Operating Experience

The review of site-specific operating experience and recent industry operating experience completed in VYNPS Report LRPD-05, Operating Experience Review Results, did not identify aging effects applicable to the RBCCW system passive mechanical components not addressed in this aging management review report. **(Ref. 9)**

4.0 Demonstration That Aging Effects Will Be Managed

The components of the RBCCW system that are subject to aging management review were described in Section 2.0. For those components, Section 3.0 documented the determination of aging effects requiring management. The aging management review is completed by demonstrating that existing programs, when continued into the period of extended operation, can manage the aging effects identified in Section 3.0. No further action is required for license renewal when the evaluation of an existing program demonstrates that it is adequate to manage the aging effect such that corrective action may be taken prior to loss of the system intended functions. Alternately, if existing programs cannot be shown to manage the aging effects for the period of extended operation, then action will be proposed to augment existing or create new programs to manage the identified effects of aging.

Demonstration for the purposes of this license renewal technical evaluation is accomplished by establishing a clear relationship among

the components under review,

the aging effects on these items caused by the material-environment-stress combinations which, if undetected, could result in loss of the intended function such that the system could not perform its function(s) within the scope of license renewal in the period of extended operation, and

the credited aging management programs whose actions serve to preserve the system intended function(s) for the period of extended operation.

Attachment 2 lists component types and identifies the aging effects requiring management for each material and environment combination. The Heat Exchanger Monitoring Program, Oil Analysis Program, Selective Leaching Program, System Walkdown Program, Water Chemistry Control – BWR Program, and Water Chemistry Control – Closed Cooling Water Program in combination will manage the effects of aging, thereby precluding loss of the intended functions of the system. Sections 4.1 through 4.6 provide the clear relationship between the component, the aging effect, and the aging management program actions which preserve the intended functions for the period of extended operation. Section 4.7 identifies applicable time-limited aging analyses. For a comprehensive review of programs credited for license renewal of VYNPS and a demonstration of how these programs will manage aging effects, see VYNPS Report LRPD-02, Aging Management Program Evaluation Results. **(Ref. 8)**

4.1 Heat Exchanger Monitoring Program

The Heat Exchanger Monitoring Program manages loss of material for the drywell atmospheric cooling units, the drywell equipment drain cooler, the recirculation pump seal water cooler tubes, the recirculation pump motor upper and lower bearing oil coolers, and the recirculation pump motor air coolers by non-destructive examinations, such as eddy-current and visual inspections performed to identify degradation prior to loss of intended function.

This program applies to component types indicated on Attachment 2. For additional information on this program, see VYNPS Report LRPD-02, Aging Management Program Evaluation Results. **(Ref. 8)**

4.2 Oil Analysis Program

The Oil Analysis Program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to aging mechanisms. This program manages loss of material for the copper alloy recirculation pump motor upper and lower bearing oil cooler surfaces that are wetted by oil.

This program applies to component types indicated on Attachment 2. For additional information on this program, see VYNPS Report LRPD-02, Aging Management Program Evaluation Results. **(Ref. 8)**

4.3 Selective Leaching Program

The Selective Leaching Program ensures the integrity of components made from gray cast iron or copper alloy susceptible to selective leaching that are exposed to raw water, untreated water, treated water, steam, untreated air, or soil (groundwater). By one-time visual inspection and testing of a representative sample of the component population, the Selective Leaching Program will verify the absence of significant loss of material due to selective leaching for RBCCW system copper alloy >15% zinc surfaces exposed to treated water.

This program applies to component types indicated on Attachment 2. For additional information on this program, see VYNPS Report LRPD-02, Aging Management Program Evaluation Results. **(Ref. 8)**

4.4 System Walkdown Program

Under the System Walkdown Program, walkdowns are conducted to manage aging effects on components. For the RBCCW system, the System Walkdown Program manages loss of material for carbon steel components by visual inspection of external surfaces. Since internal carbon steel surfaces of the drywell atmospheric cooling unit housings are exposed to the same environment as the external surfaces, external surfaces will be representative of internal surfaces. Thus, loss of material on internal carbon steel surfaces is also managed by the System Walkdown Program.

This program applies to component types indicated on Attachment 2. For additional information on this program, see VYNPS Report LRPD-02, Aging Management Program Evaluation Results. **(Ref. 8)**

4.5 Water Chemistry Control - BWR Program

To manage loss of material and cracking on the stainless steel recirculation pump seal water cooler tubes, levels of contaminants in the reactor coolant water are minimized by the Water Chemistry Control - BWR Program. The Water Chemistry Control – One-Time Inspection Program utilizes inspections or non-destructive evaluations of representative samples to verify that the Water Chemistry Control – BWR Program has been effective at managing loss of material for stainless steel components exposed to reactor coolant water.

This program applies to component types indicated on Attachment 2. For additional information on this program and the Water Chemistry Control – One-Time Inspection Program, see VYNPS Report LRPD-02, Aging Management Program Evaluation Results. **(Ref. 8)**

4.6 Water Chemistry Control – Closed Cooling Water Program

The Water Chemistry Control – Closed Cooling Water Program manages loss of material of RBCCW system carbon steel, stainless steel and copper alloy components by minimizing levels of contaminants in the water. The Water Chemistry Control – Closed Cooling Water Program also manages cracking of stainless steel recirculation pump motor air coolers by minimizing levels of contaminants in the water. The Water Chemistry Control – One-Time Inspection Program utilizes inspections or non-destructive evaluations of representative samples to verify that the Water Chemistry Control – Closed Cooling Water Program has been effective at managing aging effects for carbon and stainless steel components.

This program applies to component types indicated on Attachment 2. For additional information on this program and the Water Chemistry Control – One-Time Inspection Program, see VYNPS Report LRPD-02, Aging Management Program Evaluation Results. **(Ref. 8)**

4.7 Time-Limited Aging Analyses

This system is not exposed to elevated temperatures and the associated metal fatigue. Therefore, metal fatigue analyses are not TLAA applicable to this system.

See VYNPS Reports LRPD-03, TLAA and Exemption Evaluation Results, for further review of time-limited aging analyses. **(Ref. 2)**

5.0 Summary and Conclusions

The following aging management programs address the aging effects requiring management for the RBCCW system.

- Heat Exchanger Monitoring Program
- Oil Analysis Program
- Selective Leaching Program
- System Walkdown Program
- Water Chemistry Control – BWR Program
- Water Chemistry Control – Closed Cooling Water Program

For additional review of programs credited for license renewal of VYNPS, see VYNPS Report LRPD-02, Aging Management Program Evaluation Results.

Attachment 2 contains the aging management review results for the RBCCW System.

In conclusion, programs described in Section 4.0 will provide reasonable assurance that the effects of aging on the RBCCW system will be managed such that the intended functions will be maintained consistent with the current licensing basis throughout the period of extended operation.

6.0 References

1. EPRI Report 1003056, Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, (The Mechanical Tools)

2. VYNPS Updated Final Safety Analysis Report (UFSAR), Rev. 19-1, Sections 5.2.3.7 and 10.9

3. Document RBCCW, VYNPS Design Basis Document for Reactor Building Closed Cooling Water System, Rev. 1, 6/2/04

4. ENN-MS-S-009-VY, Vermont Yankee Site Specific Guidance and System Safety Function Sheets, Rev. 0, 3/22/05

5. Document SADBD, Topical Design Basis Document for Safety Analysis, Rev. 4

6. VYNPP Safe Shutdown Capability Analysis, Rev. 7, 6/26/04

7. VY Environmental Qualification Program Manual, Volume 1, Section 6.0, Rev. 18

8. VYNPS Report LRPD-02, Aging Management Program Evaluation Results

9. VYNPS Report LRPD-05, Operating Experience Review Results

10. Flow Diagrams

    G-191159 Sh. 1, Rev. 72, Service Water System

    G-191159 Sh. 2, Rev. 85, Service Water System

    G-191159 Sh. 3, Rev. 37, RCW Cooling Water System

    G-191159 Sh. 5, Rev. 16, Recirculation Pump Cooling Water

    G-191177 Sh. 1, Rev. 39, Radwaste Systems

11. Drawing 5920-738, Rev. 3, Primary Recirc Pump List of Materials

12. BWR QC-10, Ebasco Piping Specification, 3/15/70

13. DCR 98-007, Returning RBCCW Heat Transfer Function to NNS Designation (from SC3), 1/30/01

14. Drawing 5920-5396, Rev. 0, Drywell Equipment Drain Coil

15. VYEM 0157, Rev. 1, GE Instructions for Recirculating Water Pump Motors, 4/27/97

16. OP 2182, Rev. 24 lpc04, Reactor Building Closed Cooling Water, 9/15/03

17. Drawing 5920-10864, Rev. A, Nuclear Containment Cooling Coil

18. Drawing 5920-4229, Rev. 1, Bimetal Thermometer Wells Type 38H Extra Heavy, 6/26/00

19. Drawing 5920-3252, Rev. 2, Temp. Element Asm., 2/14/72

20. Drawing 5920-4336, Rev. 6, Switch, Liquid Flow

21. VYEM 0132, Rev. 3, Reactor Recirculation Pumps – Installation and Operation Instructions, 4/1/95

22. Drawing 5920-10865, Sh. 3, Rev. 0, Housing Assembly, Cooling Coil (Vermont Yankee Drywell Reactor Recirculation Units)

ENVIRONMENT: AIR - INDOOR (EXTERNAL)

Comp ID	Comp Type	Comp Name	Material
P-18-1A HX-1	heat exchanger (tubes)	RX RECIRC PUMP MOTOR AIR COOLERS	stainless steel
P-18-1B HX-1	heat exchanger (tubes)	RX RECIRC PUMP MOTOR AIR COOLERS	stainless steel
RBCCW-BOLTING	bolting	RBCCW SYSTEM BOLTING	carbon steel
RBCCW-BOLTING	bolting	RBCCW SYSTEM BOLTING	stainless steel

ENVIRONMENT: AIR - INDOOR (INTERNAL)

RRU-1	heat exchanger (housing)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	carbon steel
RRU-2	heat exchanger (housing)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	carbon steel
RRU-3	heat exchanger (housing)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	carbon steel
RRU-4	heat exchanger (housing)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	carbon steel

ENVIRONMENT: CONDENSATION (EXTERNAL)

Comp ID	Comp Type	Comp Name	Material
RRU-1	heat exchanger (tubes)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	copper alloy >15% zn
RRU-2	heat exchanger (tubes)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	copper alloy >15% zn
RRU-3	heat exchanger (tubes)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	copper alloy >15% zn
RRU-4	heat exchanger (tubes)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	copper alloy >15% zn

ENVIRONMENT: LUBE OIL (EXTERNAL)

Comp ID	Comp Type	Comp Name	Material
P-18-1A HX-2	heat exchanger (tubes)	RX RECIRC PUMP MOTOR UPPER AND LOWER BEARING OIL COOLERS	copper alloy >15% zn
P-18-1B HX-2	heat exchanger (tubes)	RX RECIRC PUMP MOTOR UPPER AND LOWER BEARING OIL COOLERS	copper alloy >15% zn

ENVIRONMENT: TREATED WATER (INTERNAL)

Comp ID	Comp Type	Comp Name	Material
E-ESC-1A	heat exchanger (tubes)	DRYWELL EQUIPMENT DRAIN COOLER	carbon steel
FSL-2-2-17A	flow switch housing	RECIRC PUMP A MTR COOLING LOW FLOW	carbon steel
FSL-2-2-17B	flow switch housing	RECIRC PUMP B MTR COOL LO FL.	carbon steel
FSL-2-2-23A	flow switch housing	RECIRC PUMP A COOLING WATER LOW	carbon steel
FSL-2-2-23B	flow switch housing	RECIRC PUMP B COOLING WATER LOW	carbon steel
P-18-1A HX-2	heat exchanger (tubes)	RX RECIRC PUMP MOTOR UPPER AND LOWER BEARING OIL COOLERS	copper alloy >15% zn
P-18-1A HX-3	heat exchanger (tubes)	RX RECIRC PUMP MOTOR SEAL WATER COOLER	stainless steel
P-18-1B HX-2	heat exchanger (tubes)	RX RECIRC PUMP MOTOR UPPER AND LOWER BEARING OIL COOLERS	copper alloy >15% zn
P-18-1B HX-3	heat exchanger (tubes)	RX RECIRC PUMP MOTOR SEAL WATER COOLER	stainless steel
RBCCW-PIPING	piping	RBCCW SYSTEM PIPING	carbon steel
RRU-1	heat exchanger (tubes)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	copper alloy >15% zn
RRU-2	heat exchanger (tubes)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	copper alloy >15% zn

ENVIRONMENT: TREATED WATER (INTERNAL)

Comp ID	Comp Type	Comp Name	Material
RRU-3	heat exchanger (tubes)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	copper alloy >15% zn
RRU-4	heat exchanger (tubes)	DRYWELL ATMOSPHERIC UNIT COOLING COIL	copper alloy >15% zn
RV-70-117A	valve body	RBCCW D.W. RETURN LINE RELIEF VALVE MFG. CONSOLIDATED/DRESSER	carbon steel
TE-2-2-18A	thermowell	MOTOR COOLING WATER	stainless steel
TE-2-2-18B	thermowell	MOTOR COOLING WATER	stainless steel
TE-2-2-20A	thermowell	MOTOR BEARING COOLING WATER	stainless steel
TE-2-2-20B	thermowell	MOTOR BEARING COOLING WATER	stainless steel
TE-2-2-22A	thermowell	SEAL CAVITY COOLING WATER	stainless steel
TE-2-2-22B	thermowell	SEAL CAVITY COOLING WATER	stainless steel
TI-104-3A	thermowell	RHR PUMP COOLER A INLET TEMP	carbon steel
TI-104-3B	thermowell	RHR PUMP COOLER B INLET TEMP	carbon steel
TI-104-3C	thermowell	RHR PUMP COOLER C INLET TEMP	carbon steel
TI-104-3D	thermowell	RHR PUMP COOLER D INLET TEMP	carbon steel
TI-104-45A	thermowell	CRD PUMP COOLER OUTLET WATER TEMP	carbon steel
TI-104-45B	thermowell	CRD PUMP COOLER OUTLET WATER TEMP	carbon steel
V70-106	valve body	SW GATE VALVE RADWASTE BLDG INLET LOWER LEVEL TORUS	carbon steel
V70-107	valve body	SW GLOBE VALVE RADWASTE BLDG OUTLET LOWER LEVEL TORUS	carbon steel
V70-113	valve body	SERVICE WATER CHECK VALVE	carbon steel
V70-113B	valve body	TEST CONNECTION ISOLATION VALVE FOR TESTING OF V70-113	carbon steel
V70-113D	valve body	TEST CONNECTION DRAIN VAVLE	carbon steel
V70-117	valve body	DRYWELL RRU COOLING WATER RETURN VALVE -FED FROM MCC-8B-10G FLA= 0.83 OPERATOR: SMB-00 THIS EQUIPMENT INCLUDES THE VALVE & OPERATOR	carbon steel
V70-117B	valve body	ISOLATION VAVLE FOR TESTING OF V70-117	carbon steel
V70-117D	valve body	TEST CONNECTION DRAIN VALVE	carbon steel

ENVIRONMENT: TREATED WATER (INTERNAL)

Comp ID	Comp Type	Comp Name	Material
V70-124A	valve body	SW GLOBE VALVE RHR PUMP 1A COOLER INLET LOWER LEVEL TORUS NORTH EAST CORNER ROOM	carbon steel
V70-124B	valve body	SW GLOBE VALVE RHR PUMP 1A COOLER OUTLET LOWER LEVEL TORUS NORTH EAST CORNER ROOM	carbon steel
V70-124C	valve body	SW GLOBE VALVE RHR PUMP 1C COOLER INLET LOWER LEVEL TORUS NORTH EAST CORNER ROOM	carbon steel
V70-124D	valve body	SW GLOBE VALVE RHR PUMP 1C COOLER OUTLET LOWER LEVEL TORUS NORTH EAST CORNER ROOM	carbon steel
V70-124E	valve body	SW GLOBE VALVE RHR PUMP - 1B COOLER OUTLET LOWER LEVEL TORUS SOUTH EAST CORNER	carbon steel
V70-124F	valve body	SW GLOBE VALVE RHR PUMP - 1B COOLER INLET LOWER LEVEL TORUS SOUTH EAST CORNER	carbon steel
V70-124G	valve body	SW GLOBE VALVE RHR PUMP 1D COOLER OUTLET LOWER LEVEL TORUS SOUTH EAST CORNER ROOM	carbon steel
V70-124H	valve body	SW GLOBE VALVE RHR PUMP 1D COOLER INLET LOWER LEVEL TORUS SOUTH EAST CORNER ROOM	carbon steel
V70-131A	valve body	GATE VALVE RECIRC PUMP A COOLING SUPPLY RX BLDG 252' DRYWELL AREA	carbon steel
V70-131B	valve body	GATE VALVE RECIRC PUMP B COOLING SUPPLY RX BLDG 252' DRYWELL AREA	carbon steel
V70-136	valve body	GATE VALVE EQUIP SUMP COOLER INLET RX BLDG 252' DRYWELL AREA	carbon steel
V70-137	valve body	GLOBE VALVE EQUIP SUMP COOLER OUTLET RX BLDG 252' DRYWELL AREA	carbon steel
V70-18A	valve body	RECIRC PUMP A MOTOR AIR COOLER A OUTLET VENT/DRAIN	carbon steel
V70-18B	valve body	RECIRC PUMP B MOTOR AIR COOLER B OUTLET VENT AND DRAIN	carbon steel
V70-18C	valve body	RECIRC PUMP 2A MOTOR AIR COOLER C OUTLET VENT/DRAIN	carbon steel
V70-18D	valve body	RECIRC PUMP 2B MOTOR AIR COOLER D OUTLET VENT/DRAIN.	carbon steel
V70-199A	valve body	RECIRC PUMP A COOLING OUTLET RX BLDG 252' DRYWELL AREA	carbon steel
V70-199B	valve body	RECIRC PUMP B COOLING OUTLET EXCEPT SEAL/JACKET COOLING RX BLDG 252' DRYWELL AREA	carbon steel
V70-200	valve body	SERIES VALVE RECIRC PUMP B/RRU-1 RX BLDG 252' DRYWELL AREA	carbon steel
V70-225A	valve body	GLOBE VALVE RECIRC PUMP A MOTOR AIR COOLER A OUTLET RX BLDG 252' DRYWELL AREA	carbon steel
V70-225B	valve body	GLOBE VALVE RECIRC PUMP B MOTOR AIR COOLER B OUTLET RX BLDG 252' DRYWELL AREA	carbon steel
V70-225C	valve body	GLOBE VALVE RECIRC PUMP A MOTOR AIR COOLER C OUTLET RX BLDG 252' DRYWELL AREA	carbon steel
V70-225D	valve body	GLOBE VALVE RECIRC PUMP B MOTOR AIR COOLER D OUTLET RX BLDG 252' DRYWELL AREA	carbon steel

ENVIRONMENT: TREATED WATER (INTERNAL)

Comp ID	Comp Type	Comp Name	Material
V70-225E	valve body	GLOBE VALVE RECIRC PUMP A HX COIL/JACKET COOLER RX BLDG 252' DRYWELL AREA	carbon steel
V70-225F	valve body	GLOBE VALVE RECIRC PUMP B HX COIL/JACKET COOLER OUTLET RX BLDG 252' DRYWELL AREA	carbon steel
V70-226A	valve body	RECIRC PUMP 2A FSL-17A OUTLET VENT/DRAIN RX BLDG 252' DRYWELL AREA	carbon steel
V70-226B	valve body	RECIRC PUMP 2B FSL-17B OUTLET LINE VENT/DRAIN RX BLDG 252' DRYWELL AREA	carbon steel
V70-24A	valve body	SW GATE VALVE RBCCW CLG TO CRD AND B/D RHR PUMPS LOWER LEVEL TORUS, 10 FT. ABOVE FLOOR.	carbon steel
V70-24B	valve body	SW GATE VALVE	carbon steel
V70-28	valve body	RCW-28A BYPASS RX BLDG 239' TORUS CATWALK EAST	carbon steel
V70-28A	valve body	GATE VALVE RHR/CRD PUMP COOLERS AND RADWASTE RX BLDG 239' TORUS CATWALK EAST	carbon steel
V70-29A	valve body	GATE VALVE RBCCW ALT CLG RETURN TO COOLING TOWER RX BLDG 239' TORUS CATWALK "COMBUSTIBLE FREE ZONE" G-191159, SH3, P-10 AND SH1, D-13.	carbon steel
V70-30A	valve body	SW GATE VALVE CRD PUMP 1A COOLER INLET RX BLDG 232' SW CORNER/CRD PUMP ROOM UPPER LEVEL	carbon steel
V70-30B	valve body	SW GATE VALVE CRD PUMP COOLER 1B INLET RX BLDG 232' SW CORNER/CRD PUMP ROOM UPPER LEVEL	carbon steel
V70-31A	valve body	SW GLOBE VALVE CRD PUMP 1A COOLER OUTLET RX BLDG 232' SW CORNER/CRD PUMP ROOM UPPER LEVEL	carbon steel
V70-31B	valve body	SW GLOBE VALVE CRD PUMP COOLER 1B OUTLET RX BLDG 232' SW CORNER/CRD PUMP ROOM UPPER LEVEL	carbon steel
V70-32A	valve body	SW GATE VALVE RBCCW CLG TO RADWASTE AND A/C RHR PUMPS LOWER LEVEL TORUS, 10 FT. ABOVE FLOOR.	carbon steel
V70-32B	valve body	SW GATE VALVE ALT CLG TO RADWASTE AND A/C RHR PUMPS LOWER LEVEL TORUS, 10 FT. ABOVE FLOOR.	carbon steel
V70-51A	valve body	RECIRC PUMP UPPER BEARING COOLER DISCHARGE GLOBE VALVE	carbon steel
V70-51B	valve body	RECIRC PUMP B UPPER BEARING COOLER DISCHARGE GLOBE VALVE	carbon steel
V70-51C	valve body	RECIRC PUMP A LOWER BEARING COOLER DISCHARGE GLOBE VALVE	carbon steel
V70-51D	valve body	RECIRC PUMP B LOWER BEARING COOLER DISCHARGE GLOBE VALVE	carbon steel
V70-71A	valve body	RBCW TO RRU 1, RX BLDG 252' DRYWELL AREA	carbon steel

ENVIRONMENT: TREATED WATER (INTERNAL)

Comp ID	Comp Type	Comp Name	Material
V70-71B	valve body	VALVE	carbon steel
V70-71C	valve body	VALVE	carbon steel
V70-71D	valve body	RBCCW FROM RRU 1 RX BLDG 252' DRYWELL AREA	carbon steel
V70-72A	valve body	RBCCW TO RRU-2 RX BLDG 252' DRYWELL AREA	carbon steel
V70-72B	valve body	VALVE	carbon steel
V70-72C	valve body	VALVE	carbon steel
V70-72D	valve body	RBCCW FROM RRU-2 RX BLDG 252' DRYWELL AREA	carbon steel
V70-73A	valve body	RBCCW TO RRU 3 RX BLDG 252' DRYWELL AREA	carbon steel
V70-73B	valve body	VALVE	carbon steel
V70-73C	valve body	VALVE	carbon steel
V70-73D	valve body	RBCCW FROM RRU 3 RX BLDG 252' DRYWELL AREA	carbon steel
V70-74A	valve body	RBCCW TO RRU 4 RX BLDG 252' DRYWELL AREA	carbon steel
V70-74B	valve body	VALVE	carbon steel
V70-74C	valve body	VALVE	carbon steel
V70-74D	valve body	RBCCW FROM RRU 4 RX BLDG 252' DRYWELL AREA	carbon steel

ENVIRONMENT: TREATED WATER >140°F (EXTERNAL)

Comp ID	Comp Type	Comp Name	Material
P-18-1A HX-3	heat exchanger (tubes)	RX RECIRC PUMP SEAL WATER COOLER	stainless steel
P-18-1B HX-3	heat exchanger (tubes)	RX RECIRC PUMP SEAL WATER COOLER	stainless steel

ENVIRONMENT: TREATED WATER >140°F (INTERNAL)

Comp ID	Comp Type	Comp Name	Material
P-18-1A HX-1	heat exchanger (tubes)	RX RECIRC PUMP MOTOR AIR COOLERS	stainless steel
P-18-1B HX-1	heat exchanger (tubes)	RX RECIRC PUMP MOTOR AIR COOLERS	stainless steel

ENVIRONMENT: UNTREATED WATER (EXTERNAL)

Comp ID	Comp Type	Comp Name	Material
E-ESC-1A	heat exchanger (tubes)	DRYWELL EQUIPMENT DRAIN COOLER	carbon steel

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs
Bolting	Pressure boundary	Carbon steel	Air - indoor (ext)	Loss of material	System walkdown
		Stainless steel	Air - indoor (ext)	None	None
Flow switch housing	Pressure boundary	Carbon steel	Air - indoor (ext)	Loss of material	System walkdown
			Treated water (int)	Loss of material	Water chemistry control - closed cooling water
Heat exchanger (housing)	SSR	Carbon steel	Air - indoor (ext)	Loss of material	System walkdown
			Air - indoor (int)	Loss of material	System walkdown
Heat exchanger (tubes)	Pressure boundary	Carbon steel	Treated water (int)	Loss of material	Water chemistry control - closed cooling water
			Untreated water (ext)	Loss of material	Heat exchanger monitoring
				Loss of material-wear	Heat exchanger monitoring
		Copper alloy >15% zn	Condensation (ext)	Loss of material	Heat exchanger monitoring
				Loss of material-wear	Heat exchanger monitoring
			Lube oil (ext)	Loss of material	Oil analysis
				Loss of material-wear	Heat exchanger monitoring

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs
Heat exchanger (tubes) (cont.)	Pressure boundary	Copper alloy >15% zn	Treated water (int)	Loss of material	Selective leaching
					Water chemistry control - closed cooling water
		Stainless steel	Air - indoor (ext)	Loss of material-wear	Heat exchanger monitoring
			Treated water (int)	Loss of material	Water chemistry control - closed cooling water
			Treated water >140°f (ext)	Cracking	Water chemistry control – BWR
				Loss of material	Water chemistry control - BWR
				Loss of material-wear	Heat exchanger monitoring
			Treated water >140°f (int)	Cracking	Water chemistry control - closed cooling water
				Loss of material	Water chemistry control - closed cooling water
Piping	Pressure boundary	Carbon steel	Air - indoor (ext)	Loss of material	System walkdown
			Treated water (int)	Loss of material	Water chemistry control - closed cooling water

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs
Thermowell	Pressure boundary	Carbon steel	Air - indoor (ext)	Loss of material	System walkdown
			Treated water (int)	Loss of material	Water chemistry control - closed cooling water
		Stainless steel	Air - indoor (ext)	None	None
			Treated water (int)	Loss of material	Water chemistry control - closed cooling water
Valve body	Pressure boundary	Carbon steel	Air - indoor (ext)	Loss of material	System walkdown
			Treated water (int)	Loss of material	Water chemistry control - closed cooling water