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VERIFICATION OF PNPS LICENSE RENEWAL PROJECT REPORT

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Title of Report: **Aging Management Review of the Salt Service Water System**

Report Number: **AMRM-11**

Revision: **1**

This report documents evaluations related to the **PNPS License Renewal Project.** Signatures certify that the above report was prepared, checked and reviewed by the license renewal project team in accordance with the PNPS license renewal project guidelines and that it was reviewed and approved by the ENI License Renewal Project Manager and PNPS project management in accordance with PNPS procedures.

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
1	To add valves 29-HO-3975B and 29-HO-3976B to Attachment 1 to reflect an updated flow diagram M212 sheet 1 as part of the annual review. For additional details of the annual review, see LRPD-07.	Attachment 1 All pages changed to revision 1.

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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 Pilgrim Nuclear Power Station (PNPS). This report demonstrates the effects of aging on the salt service water (SSW) 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 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. 4)**. This EPRI report provides the bases for identification of aging effects based on specific materials and environments and documents confirmation of the validity of 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 SSW system.

1.2 System Description

As described in section 10.7 of the UFSAR, the SSW system consists of five vertical pumps located in the intake structure and the associated piping, valves and instrumentation. The pumps discharge to two independent loops that each supply cooling water to one reactor building closed cooling water (RBCCW) heat exchanger and one turbine building closed cooling water (TBCCW) heat exchanger. From the outlet of the heat exchangers, the water returns to the bay. **(Ref. 1, 2, 3)**

The PNPS SSW system consists of:

- service water pumps
- TBCCW heat exchangers
- insulating flanges
- service water piping and tubing
- service water valves
- orifices

The SSW system also includes a permanent piping connection from the SSW pumps to the residual heat removal (RHR) system to provide an emergency source of water to cool the reactor. Inadvertent operation of this flow path is prevented by two manual valves and a spectacle flange that would have to be reversed for the flow path to be used. **(Ref. 1, 2, 3)**

The SSW system can supply water to the screen wash pumps to support cleaning the traveling water screens. The SSW system can supply water to the triplex filter as an alternate supply of cooling water to the circulating water pumps. **(Ref. 1, 2, 3)**

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

1.3 <u>System and Component Intended Functions</u>

As described in UFSAR Section 10.7, the SSW system provides cooling for the RBCCW and TBCCW heat exchangers. Supplying cooling water to RBCCW heat exchangers is a safety function that must be maintained under normal operation and accident conditions. Cooling water flow to TBCCW heat exchangers is required to support power generation but is not required under accident conditions. **(Ref. 2)**

The SSW can be used as a source of water for reactor pressure vessel (RPV) injection or primary containment flooding when directed by emergency operating procedures for a severe accident beyond the plant design basis. **(Ref. 2, 3)**

Supplying water to screen wash pumps is not required during accident conditions. The supply valves to screen wash pumps are interlocked to close during accident conditions to ensure water is supplied to the RBCCW heat exchangers. Outlet valves on TBCCW heat exchangers will throttle to ensure the required flowrate is supplied to RBCCW heat exchangers under accident conditions with a loss of offsite power. The supply to the triplex filter for circulating water pump operation is not a safety function since it is only required to support circulating water pump operation for electrical power generation and is not required for accident analyses or license renewal regulated events. **(Ref. 2, 3)**

The SSW system mechanical components perform a function that demonstrates compliance with the Commission's regulations for fire protection (10 CFR 50.48) since the SSW system is credited with providing cooling following a fire. The SSW system 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 environmental qualification (10 CFR 50.49), pressurized thermal shock (10 CFR 50.61 - not applicable to BWRs), anticipated transients without scram (10 CFR 50.62), or station blackout (10 CFR 50.63). **(Ref. 2, 3, 10, 11, 12, 13, 14)**

System components outside of the safety class boundary of the SSW 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 PNPS Report AMRM-30, Aging Management Review of Nonsafety-related Systems and Components Affecting Safety-related Systems. For PNPS 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 safety class piping.

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

Refer to PNPS Report LRPD-01, System and Structure Scoping Report for additional information on scoping and intended functions 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, heat exchangers, orifices, pump casings, piping, tubing, and valve bodies in the SSW system are passive, long-lived components.

The components of the SSW system reviewed in this AMRR are: **(Ref. 1, 2, 3)**

- intake structure sluice gates
- SSW pumps
- SSW pump discharge lines, headers, and components,
- TBCCW heat exchangers (for pressure boundary only)
- piping and components in the heat exchanger outlets up to the discharge structure sealwell
- SSW supply piping and components up to the normally closed isolation valves AO-3915 and AO-3925 (upstream of the screen wash pumps)
- SSW piping and components up to normally closed valves 29-HO-3882 and 29-HO-3884 (upstream of the triplex filter for the circulating water pumps cooling supply)

The SSW system utilizes safety-related solenoid valves to bleed air off of actuators so the associated valves achieve the desired position. Pressure boundary integrity is not required for these valves since the associated component fails to the desired position on a loss of air pressure. Therefore, these safety-related valves do not require aging management review. A list of these valves is provided below.

SV-3915
SV-3925

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

There are elastomer expansion joints utilized in the SSW system. These are not long lived components since they are periodically replaced. Therefore these expansion joints do not require an aging management review. **(Ref. 24)**

The structural components of the pump bays are reviewed in structural AMRRs.

The RBCCW heat exchangers are reviewed in the RBCCW AMRR (AMRM-12). The piping and valves (vents and drains) on the salt service water side of the RBCCW heat exchanger are reviewed in this AMRR. **(Ref. 3)**

The emergency backup supply piping and components for SSW supply to the RHR system is for beyond design basis events and does not require aging management review. **(Ref. 1, 2, 3)**

The intake structure ventilation is reviewed as required in the HVAC AMRR (AMRM-19).

A list of SSW system passive mechanical components subject to aging management review is included as Attachment 1. The P&ID associated with this system, highlighted to identify components requiring aging management review, is LRA drawing LRA-212, sheet 1. **(Ref. 1)**

3.0 Aging Effects Requiring Management

EPRI reports 1003056 and 1002950 are 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 components are cracking (i.e., crack initiation, crack growth, and through-wall cracking), change in material properties, fouling and loss of material. For additional information on aging effects, refer to the EPRI reports. **(Ref. 4, 19)**

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

The SSW system is normally in operation. During normal plant operation, the temperatures for components in this AMRR remain within the range of ocean temperature plus the temperature rise across the system such that at the outlets of the heat exchangers, temperatures will not normally exceed 80°F for the RBCCW and 95°F for the TBCCW. **(Ref. 3)**

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

3.1 <u>Carbon Steel Components</u>

The SSW system includes carbon steel components (including cast iron), the majority of which are rubber lined. Since for the purposes of identifying aging effects the liner is not credited with a protective function, aging effects are identified for carbon steel in contact with salt water. Some carbon steel piping is above ground and some is below ground. See Attachment 1 for a list of carbon steel components. The component type "piping" used in this report also includes the insulating flanges on the system. **(Ref. 1, 6, 17)**

The generic component type "valve body" is used for the intake structure sluice gates to describe the pressure boundary even though it does not have a separate "body" for the pressure boundary. These components are identified as exposed to low temperature raw water on internal surfaces (even though they do not actually have an "internal surface") and condensation that may include some salt water on external surfaces to match the standard terminology and identify bounding aging effects for these components.

Loss of material due to general corrosion, pitting corrosion, crevice corrosion, MIC, erosion, and galvanic corrosion (where different materials are in contact with carbon steel) is an aging effect requiring management for internal surfaces of carbon steel components exposed to raw water.

Condensation (including salt water) may occur on un-insulated surfaces when the surface temperature is less than or equal to the dew point of the surrounding air. Loss of material due to general, pitting, crevice, and galvanic corrosion is an aging effect requiring management for external carbon steel surfaces exposed to condensation.

Components that are underground (piping exposed to soil and groundwater) or aboveground and continuously wetted may be protected by a coating. Since the coating does not have a specified life, aging effects are evaluated as if the carbon steel was not coated. Loss of material due to general corrosion, pitting corrosion, crevice corrosion, MIC, and galvanic corrosion is an aging effect requiring management. Loss of material from selective leaching is an aging effect requiring management for gray cast iron components.

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.

3.2 Titanium Components

Titanium piping and thermowells are used in sections of the SSW system. The component type "piping" used in this report also includes the insulating flanges on the system. These components are exposed to low temperature raw water on internal surfaces and condensation (that may include salt water) or soil on external surfaces. **(Ref. 1, 2, 3)**

Titanium is inherently resistant to general corrosion, pitting corrosion, crevice corrosion, and erosion in raw water at temperatures less than 160°F. However, in raw water, MIC can result in loss of material from titanium. Therefore, loss of material due to MIC is an aging effect requiring management for internal surfaces.

Cracking from stress corrosion and intergranular attack is not an aging effect requiring management for titanium due to the inherent resistance of titanium to these mechanisms.

Cracking due to thermal fatigue is not an aging effect requiring management since the system operates at low temperatures.

Titanium exposed intermittently to condensation does not experience aging effects as MIC requires a continuously wetted surface. Loss of material due to MIC from external buried titanium surfaces is an aging effect requiring management.

3.3 Copper Alloy Components

The SSW system pump casings, some system valves, and tubing are constructed of copper alloy[1]. The tubing will have <15% zinc but some of the valves are conservatively assumed to contain >15% zinc when identifying aging effects.[2] These components are exposed to low temperature raw water on internal surfaces and

[1] The pumps are aluminum bronze per page 79 of reference 3. This is a copper alloy.

[2] Per reference 8, the original copper alloy valves are ASTM B-61 and B-62, which contain less than 15% zinc. Therefore the >15% zinc case is only conservatively included to cover any valve material changes.

condensation (that may include salt water) or low temperature raw water (for submerged components such as the pump casings) on external surfaces. **(Ref. 3, 17)**

Loss of material due to pitting corrosion, crevice corrosion, MIC, erosion, and selective leaching is an aging effect requiring management for internal surfaces of copper alloy components that are assumed to be >15% zinc or aluminum bronze that is not inhibited by the addition of arsenic. Selective leaching is not applicable to those components that are less than 15% zinc or is inhibited by the addition of alloying elements such as tin, phosphorous, arsenic and antimony.

For external surfaces exposed to a continuously wetted environment (submerged or exposed to salt water splash such as the pump casings), loss of material due to MIC, pitting corrosion, crevice corrosion, and selective leaching is an aging effect requiring management.

The system operates at low temperatures. Therefore, cracking due to thermal fatigue is not an applicable aging effect for SSW system components.

Stress corrosion cracking/intergranular attack is not a concern for copper alloy since an ammonia environment is not present.

3.4 Nickel Alloy Components

Some system valves are constructed of nickel alloy (Monel). These components are exposed to low temperature raw water on internal surfaces and condensation (that may include salt water) on external surfaces. **(Ref. 27)**

Loss of material due to pitting corrosion, crevice corrosion, and MIC is an aging effect requiring management for internal surfaces of nickel alloy components.

For external surfaces exposed to a condensation, loss of material due to pitting corrosion, crevice corrosion, and MIC is an aging effect requiring management.

The system operates at low temperatures. Therefore, cracking due to thermal fatigue is not an applicable aging effect for SSW system components.

3.5 Stainless Steel Components

Some instrument tubing and orifices in the SSW system are stainless steel. **(Ref. 25, 26)** The tubing internal surfaces are exposed to raw water (salt service water). External tube surfaces are exposed to condensation (that may include salt water).

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.

Reduction of fracture toughness due to thermal embrittlement is not an aging effect requiring management for cast austenitic stainless steel (CASS) components, since the operating temperature remains below the 482°F threshold for stainless steel thermal embrittlement.

Loss of material from pitting and crevice corrosion is conservatively identified as an aging effect requiring management for stainless steel external surfaces since they may be exposed to condensation including salt water.

3.6 <u>TBCCW Heat Exchangers (E-122A, B)</u>

The SSW wetted sub-components of the TBCCW heat exchangers are constructed of copper alloy with less than 15% zinc (90/10 copper nickel per reference 7). The basic construction is copper alloy tubes, tube sheets, and end channels that are identified in the generic component type "tubes". The carbon steel shell and baffles are assigned the generic component type "shell". The portions of the heat exchanger exposed to treated water (TBCCW) are the internal surface of the carbon steel shell, the carbon steel baffles, and the external surface of the copper alloy tubes. Tube internal surfaces are exposed to raw water (salt service water). External shell surfaces are exposed to condensation. **(Ref. 7)**

Heat transfer is not a required function of these heat exchangers. They are only required to support the SSW system pressure boundary. Therefore, fouling is not an aging effect requiring management.

Loss of material due to pitting corrosion, crevice corrosion, MIC, erosion, and wear (wear is on external tube surface only) is an aging effect requiring management for copper alloy sub-components in these heat exchangers. Selective leaching is not a concern since the copper alloy does not contain greater than 15% zinc.

Loss of material due to general corrosion, pitting corrosion, crevice corrosion, galvanic corrosion, MIC, and erosion is an aging effect requiring management for carbon steel internal surfaces of the heat exchangers.

The system temperature remains low since it is ocean water. Therefore, cracking due to thermal fatigue is not an applicable aging mechanism for the heat exchangers.

Stress corrosion cracking/intergranular attack is not a concern for copper alloy since an ammonia environment is not present.

Loss of material from general, pitting, crevice and galvanic corrosion is an aging effect requiring management for carbon steel external surfaces since they are exposed to condensation.

3.7 Bolting

Pressure retaining bolting in this system may be stainless steel, carbon steel or nickel alloy and is exposed to condensation (which may include salt water) or submerged in raw water. **(Ref. 17)**

Loss of material due to MIC and general, pitting, crevice and galvanic corrosion is an aging effect requiring management for carbon steel bolting exposed to a condensation or soil.

Some of the pump bolting is nickel alloy and is submerged. Loss of material due to MIC, pitting, and crevice corrosion is an aging effect requiring management for nickel alloy bolting exposed to a wetted environment. **(Ref. 17)**

Loss of material due to pitting and crevice corrosion is identified as an aging effect requiring management for the stainless steel bolting exposed to condensation.

3.8 Operating Experience

The review of site-specific operating experience and recent industry operating experience completed in PNPS Report LRPD-05, Operating Experience Review Report, did not identify aging effects applicable to the SSW system passive mechanical components not addressed in this aging management review report. **(Ref. 21)**

The operating experience has resulted in many enhancements to the original component materials to utilize materials that are more resistant to loss of material in salt water. While individual component materials listed on Attachment 1 are expected to change as future modifications are completed, the current Attachment 2 has been prepared to bound the expected materials and environment combinations. Use of improved materials should reduce the aging effects experienced by these components. **(Ref. 27)**

4.0 Demonstration That Aging Effects Will Be Managed

The components of the SSW system requiring 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(s) 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:

1) the components under review,

2) the aging effects on these items caused by the material-environment-stress combinations which, if undetected, could result in the 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

3) 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 aging effects requiring management for each material and environment combination. The Water Chemistry Control-CCW Program, System Walkdown Program, Buried Piping and Tanks Inspection Program, Service Water Integrity Program, and Selective Leaching Program in combination will manage the effects of aging, thereby precluding loss of the intended functions of the system. Sections 4.1 through 4.5 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 4.6 identifies applicable time-limited aging analyses. For a comprehensive review of programs credited for license renewal of PNPS and a demonstration of how these programs will manage aging effects, see PNPS Report LRPD-02, Aging Management Program Evaluation Report.

4.1 Water Chemistry Control – Closed Cooling Water Program

The Water Chemistry Control – Closed Cooling Water Program manages loss of material for the TBCCW heat exchanger components that are wetted by treated water 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 loss of material for the TBCCW heat exchangers.

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 PNPS Report LRPD-02, Aging Management Program Evaluation Report. **(Ref. 18)**

4.2 System Walkdown Program

Under the System Walkdown Program, visual inspections are conducted to manage aging effects on components. For the SSW system, the System Walkdown Program manages loss of material for external carbon steel, stainless steel, and copper alloy components by visual inspection of external surfaces.

This program applies to component types indicated on Attachment 2. For additional information on this program, see PNPS Report LRPD-02, Aging Management Program Evaluation Report. **(Ref. 18)**

4.3 Buried Piping and Tanks Inspection Program

The Buried Piping and Tanks Inspection Program manages loss of material from external surfaces of buried carbon steel and titanium components by visual inspection.

This program applies to component types indicated on Attachment 2. For additional information on the Buried Piping and Tanks Inspection Program, see PNPS Report LRPD-02, Aging Management Program Evaluation Report. **(Ref. 18)**

4.4 Service Water Integrity Program

The Service Water Integrity Program includes condition and performance monitoring activities to inspect components for erosion and corrosion. Chemical treatment using biocides and chlorine and periodic cleaning and flushing of redundant or infrequently used loops are additional methods used under this program to manage loss of material in SSW carbon steel, nickel alloy, stainless steel, titanium and copper alloy components.

This program applies to component types indicated on Attachment 2. For additional information on this program, see PNPS Report LRPD-02, Aging Management Program Evaluation Report. **(Ref. 18)**

4.5 Selective Leaching Program

The Selective Leaching Program ensures the integrity of components made from gray cast iron or copper alloys 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 for SSW system copper alloy components that are susceptible to selective leaching.

This program applies to component types indicated on Attachment 2. For additional information on this program, see PNPS Report LRPD-02, Aging Management Program Evaluation Report. **(Ref. 18)**

4.6 Time-Limited Aging Analyses

This system is not exposed to elevated temperatures and the associated metal fatigue. Therefore, metal fatigue analyses are not time-limited aging analyses (TLAA) applicable to this system.

Corrosion allowances for the system piping are considered TLAA and are evaluated in LRPD-03, TLAA and Exemption Evaluation Report.

See PNPS Reports LRPD-03, TLAA and Exemption Evaluations, and LRPD-06, Time-Limited Aging Analyses – Mechanical Fatigue, for further review of time-limited aging analyses. **(Ref. 22, 23)**

5.0 Summary and Conclusions

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

- Water Chemistry Control-Closed Cooling Water Program
- System Walkdown Program
- Buried Piping and Tanks Inspection Program
- Service Water Integrity Program
- Selective Leaching Program

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

Attachment 2 contains the aging management review results for the SSW system.

In conclusion, the programs described in Section 4.0 will provide reasonable assurance that the effects of aging on the PNPS SSW 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. Piping & Instrument Diagram M-212, Sh. 1, Rev. E87, Service Water System

2. PNPS Updated Final Safety Analysis Report (UFSAR) Revision 24, Section 10.7, 10.9, A.9

3. SDBD-29, Revision E1, System Design Basis Document for the SSW System

4. EPRI Report 1003056, *Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3*

5. Procedure 2.2.32, Rev. 70, SSW System Operating Procedure

6. M-614, Rev. 1, Pilgrim Unit 1 Specification for Design and Installation of Tubing and Instruments

7. Vendor Manuals
   V-0305, Rev. 29, Goulds Pumps
   V-1041, Rev. 11, Engineering & Fabricators, Inc. Heat Exchangers

8. M-300, Rev. E55, Pilgrim Unit 1 Specification/Report for Piping

9. Pilgrim Nuclear Power Station Q-List, Rev. E82

10. TDBD-122, Rev. E1, Pilgrim Nuclear Power Station Topical Design Basis Document for Anticipated Transient Without Scram (ATWS)

11. TDBD-115, Rev. E0, Pilgrim Nuclear Power Station Topical Design Basis Document for Station Blackout

12. TDBD-105, Rev. E0, Pilgrim Nuclear Power Station Topical Design Basis Document for Fire Protection and Appendix R Program

13. TDBD-103, Rev. E0, Pilgrim Nuclear Power Station Topical Design Basis Document for Environmental Qualification

14. Calculation Number PS 32, Rev. 5, Appendix R Safe Shutdown Analysis Report

15. PNPS Updated Final Safety Analysis Report (UFSAR) Revision 24, Section A.9

16. no longer used

17. Drawing M8-4, Rev. E26, Assembly Drawing, Service Water Pump P208A, B, C, D, & E

18. PNPS Report LRPD-02, Aging Management Program Evaluation Report

19. EPRI 1002950, Aging Effects for Structures and Structural Components (Structural Tools), Rev. 1, August, 2003

20. Email from Dave Heard to Stan Batch, FRN91-01-62 for valve materials of sluice gates

21. PNPS Report LRPD-05, Operating Experience Review Report

22. PNPS Report LRPD-03, TLAA and Exemption Evaluations

23. PNPS Report LRPD-06, Time-Limited Aging Analyses – Mechanical Fatigue

24. Emails from Dave Heard to Stan Batch, March 16 and 21, 2005 to revise all PMs for expansion joints to have periodic replacement specified

25. Emails from Dave Heard to Stan Batch, May 18 and June 14 2005 (identified some instrument tubing is stainless steel and the thermowells are titanium)

26. Orifice Plate Metering Data Sheet M206DS53-1

27. Email from Joe Gaedtke/Dave Heard dated July 29, 2005

Component ID	Component Type	Material[3]	Reference
29-CK-3880A	valve body	copper alloy	1, 8, 27
29-CK-3880B	valve body	nickel alloy	27
29-CK-3880C	valve body	copper alloy	1, 8, 27
29-CK-3880D	valve body	nickel alloy	27
29-CK-3880E	valve body	copper alloy	1, 8, 27
29-HO-116A	valve body	carbon steel	1, 8
29-HO-116B	valve body	carbon steel	1, 8
29-HO-14A	valve body	carbon steel	1, 8
29-HO-14B	valve body	carbon steel	1, 8
29-HO-15B	valve body	carbon steel	1, 8
29-HO-19A	valve body	carbon steel	1, 8
29-HO-19B	valve body	carbon steel	1, 8
29-HO-20A	valve body	carbon steel	1, 8
29-HO-20B	valve body	carbon steel	1, 8
29-HO-38	valve body	carbon steel	1, 8
29-HO-3814	valve body	carbon steel	27
29-HO-3815	valve body	carbon steel	27
29-HO-3816	valve body	carbon steel	27
29-HO-3817	valve body	carbon steel	27
29-HO-3818	valve body	carbon steel	27
29-HO-3819	valve body	carbon steel	1, 8
29-HO-3823	valve body	carbon steel	1, 8
29-HO-3824	valve body	carbon steel	1, 8
29-HO-3825	valve body	carbon steel	1, 8
29-HO-3826	valve body	carbon steel	1, 8
29-HO-3827	valve body	carbon steel	27
29-HO-3828	valve body	carbon steel	1, 8
29-HO-3829	valve body	carbon steel	1, 8
29-HO-3830	valve body	carbon steel	1, 8
29-HO-3831	valve body	carbon steel	1, 8
29-HO-3832	valve body	carbon steel	27
29-HO-3833	valve body	carbon steel	1, 8
29-HO-3834	valve body	carbon steel	1, 8
29-HO-3835	valve body	copper alloy	27

[3] Valve materials are presented in this listing that are believed to bound all materials that are used, but individual valve materials may not be accurate. For example valves of both copper alloy >15% zinc and copper alloy <15% zinc are identified in Attachment 2 to cover both possible types.

Attachment 1 - Components Subject to AMR

Component ID	Component Type	Material[3]	Reference
29-HO-3836	valve body	carbon steel	1, 8
29-HO-3837	valve body	carbon steel	27
29-HO-3838	valve body	carbon steel	1, 8
29-HO-3839	valve body	carbon steel	1, 8
29-HO-3840	valve body	copper alloy	27
29-HO-3841	valve body	copper alloy	27
29-HO-3842	valve body	carbon steel	27
29-HO-3844	valve body	copper alloy	27
29-HO-3845	valve body	copper alloy	27
29-HO-3846	valve body	copper alloy	27
29-HO-3847	valve body	copper alloy	27
29-HO-3848	valve body	copper alloy	27
29-HO-3869A	valve body	copper alloy	27
29-HO-3869B	valve body	copper alloy	27
29-HO-3870A	valve body	copper alloy	27
29-HO-3870B	valve body	copper alloy	27
29-HO-3871A	valve body	copper alloy	27
29-HO-3871B	valve body	copper alloy	27
29-HO-3872A	valve body	copper alloy	27
29-HO-3872B	valve body	copper alloy	27
29-HO-3875B	valve body	copper alloy	27
29-HO-3878A	valve body	copper alloy	27
29-HO-3878B	valve body	copper alloy	27
29-HO-3878C	valve body	copper alloy	27
29-HO-3878D	valve body	copper alloy	27
29-HO-3878E	valve body	copper alloy	27
29-HO-3879A	valve body	copper alloy	27
29-HO-3879B	valve body	copper alloy	27
29-HO-3879C	valve body	copper alloy	27
29-HO-3879D	valve body	copper alloy	27
29-HO-3879E	valve body	copper alloy	27
29-HO-3881A	valve body	carbon steel	1, 8
29-HO-3881B	valve body	carbon steel	1, 8
29-HO-3882	valve body	copper alloy	1, 8, 27
29-HO-3884	valve body	copper alloy	1, 8, 27
29-HO-3887	valve body	copper alloy	27

Component ID	Component Type	Material[3]	Reference
29-HO-3915A	valve body	copper alloy	27
29-HO-3915B	valve body	copper alloy	27
29-HO-3929B	valve body	copper alloy	27
29-HO-3930A	valve body	copper alloy	27
29-HO-3930B	valve body	copper alloy	27
29-HO-3975B	valve body	copper alloy	27
29-HO-3976B	valve body	copper alloy	27
29-HO-39A	valve body	copper alloy	27
29-HO-3A	valve body	copper alloy	27
29-HO-3B	valve body	copper alloy	27
29-HO-4A	valve body	copper alloy	27
29-HO-4B	valve body	copper alloy	27
29-HO-50A	valve body	copper alloy	27
29-HO-50B	valve body	copper alloy	27
29-HO-51A	valve body	copper alloy	27
29-HO-51B	valve body	copper alloy	27
29-HO-52A	valve body	copper alloy	27
29-HO-52B	valve body	copper alloy	27
29-HO-53A	valve body	copper alloy	27
29-HO-53B	valve body	copper alloy	27
29-HO-54A	valve body	copper alloy	27
29-HO-54B	valve body	copper alloy	27
29-HO-58	valve body	copper alloy	27
29-HO-5A	valve body	copper alloy	27
29-HO-5B	valve body	copper alloy	27
29-HO-6A	valve body	copper alloy	27
29-HO-6B	valve body	copper alloy	27
29-HO-8A	valve body	copper alloy	27
29-HO-8B	valve body	copper alloy	27
29-HO-9A	valve body	copper alloy	27
29-HO-9B	valve body	copper alloy	27
AV-38003	valve body	copper alloy	1, 8, 27
AV-38004	valve body	copper alloy	1, 8, 27
AV-38005	valve body	copper alloy	1, 8, 27
AV-38006	valve body	copper alloy	1, 8, 27
AV-38007	valve body	copper alloy	1, 8, 27
AO-3915	valve body	carbon steel	1, 8

Component ID	Component Type	Material[3]	Reference
AO-3925	valve body	carbon steel	1, 8
E-122A	heat exchanger tubes	copper alloy (90-10 CU-NI)	7
	heat exchanger shell	carbon steel	7
E-122B	heat exchanger tubes	copper alloy (90-10 CU-NI)	7
	heat exchanger shell	carbon steel	7
FE 6240	orifice	stainless steel	26
FE 6241	orifice	stainless steel	26
MO-3800	valve body	carbon steel	27
MO-3801	valve body	carbon steel	27
MO-3805	valve body	carbon steel	27
MO-3806	valve body	carbon steel	27
MO-3808	valve body	carbon steel	27
MO-3813	valve body	carbon steel	27
P-208A	pump casing	copper alloy (aluminum bronze uninhibited)	17
P-208B	pump casing	copper alloy (aluminum bronze uninhibited)	17
P-208C	pump casing	copper alloy (aluminum bronze uninhibited)	17
P-208D	pump casing	copper alloy (aluminum bronze uninhibited)	17
P-208E	pump casing	copper alloy (aluminum bronze uninhibited)	17

Component ID	Component Type	Material	Reference
X-367A	valve body	cast iron- but not gray cast iron so identified as carbon steel	1, 8, 20
X-367B	valve body	cast iron- but not gray cast iron so identified as carbon steel	1, 8, 20
X-367C	valve body	cast iron- but not gray cast iron so identified as carbon steel	1, 8, 20
SSW Bolting	bolting	carbon steel	1, 2, 8
SSW Bolting	bolting	nickel alloy (Monel)	26
SSW Bolting	bolting	stainless steel	1, 2, 8
SSW Pipe	piping	carbon steel	1, 8
SSW Pipe	piping	titanium	1, 8
SSW Thermowells	thermowells	titanium	25
SSW Tubing	tubing	stainless steel	25
SSW Tubing	tubing	copper alloy <15% zinc	6
SSW >15% zinc valves	valve	copper alloy >15% zinc	see footnote[4]

[4] Per reference 8, the original copper alloy valves are ASTM B-61 and B-62, which contain less than 15% zinc. Therefore the >15% zinc valve is only conservatively included to cover any valve material changes.

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program
Bolting	Pressure boundary	Carbon steel	Condensation (ext)	Loss of material	System walkdown
			Soil (ext)	Loss of material	Buried piping and tanks inspection
		Nickel alloy	Condensation (ext)	Loss of material	System walkdown
			Raw water (ext)	Loss of material	Service water integrity
		Stainless steel	Condensation (ext)	Loss of material	System walkdown
Heat exchanger (tubes)	Pressure boundary	Copper alloy (<15% zinc)	Raw water (int)	Loss of material	Service water integrity
			Treated water (ext)	Loss of material	Water Chemistry Control-closed cooling water
				Loss of material-wear	Service water integrity
Heat exchanger (shell)	Pressure boundary	Carbon steel	Condensation (ext)	Loss of material	System walkdown
			Treated water (int)	Loss of material	Water Chemistry Control-closed cooling water
Orifice	Pressure boundary and flow control	Stainless steel	Condensation (ext)	Loss of material	System walkdown
			Raw water (int)	Loss of material	Service water integrity
Piping	Pressure boundary	Carbon steel	Condensation (ext)	Loss of material	System walkdown
			Raw water (int)	Loss of material	Service water integrity
			Soil (ext)	Loss of material	Buried piping and tanks inspection
		Titanium	Condensation (ext)	none	none
			Raw water (int)	Loss of material	Service water integrity
			Soil (ext)	Loss of material	Buried piping and tanks inspection

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program
Pump casing	Pressure boundary	Copper alloy (aluminum bronze)	Raw water (int)	Loss of material	Service water integrity
					Selective leaching
			Raw water (ext)	Loss of material	Service water integrity
					Selective leaching
Thermowells	Pressure boundary	Titanium	Condensation (ext)	none	none
			Raw water (int)	Loss of material	Service water integrity
Tubing	Pressure boundary	Copper alloy (<15% zinc)	Condensation (ext)	Loss of material	System walkdown
			Raw water (int)	Loss of material	Service water integrity
		Stainless steel	Condensation (ext)	Loss of material	System walkdown
			Raw water (int)	Loss of material	Service water integrity
Valve body	Pressure boundary	Carbon steel	Condensation (ext)	Loss of material	System walkdown
			Raw water (int)	Loss of material	Service water integrity
			Raw water (ext)	Loss of material	Service water integrity
		Copper alloy (<15% zinc)	Condensation (ext)	Loss of material	System walkdown
			Raw water (int)	Loss of material	Service water integrity
		Copper alloy (>15% zinc)	Condensation (ext)	Loss of material	System walkdown
			Raw water (int)	Loss of material	Service water integrity
					Selective leaching
		Nickel alloy	Condensation (ext)	Loss of material	System walkdown
			Raw water (int)	Loss of material	Service water integrity

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