Question
RAI B.1.40-2 (Service Water Integrity)

Background
For the "preventive actions" program element, Section 4.11 of RBS-EP-15-00007 states that corrosion products are insignificant due to the water treatment for the normal service water system; therefore, periodic flushing was not identified as part of RBS' response to GL 89 13 and is not performed by the Service Water Integrity program. RBS' initial response, dated February 2, 1990, for GL 89-13 Action Item I discusses the need to verify flow in portions of infrequently used cooling loops in the service water system.

Several plant-specific condition reports (e.g., CR-RBS-2008-03885, CR RBS 2011 03700, CR-RBS-2011-08119, CR-RBS-2012-01217, CR-RBS-2014-05562, and CR-RBS-2017-01659) document high differential pressures across the normal service water inlet strainers to the service water cooling heat exchangers. CR-RBS-2012-01217 states that the preventive maintenance frequency to clean the strainers needs to be updated to prevent excessive clogging and that the debris found in the strainer appears to be mostly rust particles.

Issue
Based on the plant-specific condition reports over several years, periodic high differential pressures across strainers, with the debris in some instances consisting mostly of rust particles, indicates that more than a minimal amount of corrosion products exist in the system. In addition, the existence of a preventive maintenance activity to clean the strainer indicates that some level of fouling is ongoing in the system. It is not clear to the staff that corrosion products are insignificant due to the water treatment in the normal service water system. Consequently, flushing of infrequently used cooling loops may be warranted.

Request
Provide additional information to support the current Service Water Integrity program's lack of preventive actions, such as periodic flushing, based on the plant-specific condition reports over several years with high differential pressures across strainers in the system.

Response

Note: A previous response to RAI B.1.40-2 was submitted by letter RBG-47834, dated March 8, 2018. Due to subsequent discussion between NRC and Entergy personnel, the response is revised, superseding the previous response in letter RBG-47834. The locations of changes are indicated with revision bars.

Generic Letter 89-13 required for open-loop service water systems that sites implement and maintain an ongoing program of surveillance and control techniques to significantly reduce the incidence of flow blockage problems as a result of biofouling. The RBS normal service water system was originally an open-loop system using raw water. This configuration was modified to a closed-loop system using demineralized water in the early 1990s, which eliminated the biofouling and greatly reduced the corrosion rates of components in the normal service water system.

Because the normal service water system is in service during plant operation, the service water cooling heat exchanger inlet strainers screen a large volume of water. The strainers have small 3/32 inch diameter holes. Rust in the strainer debris may have been formed during operation prior to modification of the system configuration. Small amounts of this rust can occasionally be

dislodged by flow and be collected as designed in the strainers. The strainers are routinely monitored for differential pressure, and operators back flush them as needed. The back flushing activity may not eliminate all trapped material, so the full margin to the alarm setpoint is sometimes not restored until the strainer is disassembled and cleaned. The discussion of strainer performance in the corrective actions of CR-RBS-2012-01217 stated that the strainer last required removal and cleaning in 2000. The buildup was gradual enough that the differential pressure across the strainers could be monitored and cleaning scheduled before there was an adverse impact on system performance. The gradual increase in strainer differential pressure documented in these condition reports does not represent a concern with the water chemistry control that would indicate a need for periodic flushing of infrequently used cooling loops.

RBS has had experience with normal service water drain lines that were plugged when draining was performed. When chemically cleaning the system following its conversion to a closed-loop system, many drains were not flushed because the drain flow path is required only to support maintenance. Therefore, the drain plugging that was identified in the operating experience does not indicate a concern with the normal service water quality.

The water quality of the closed-loop normal service water system is controlled to minimize scaling, corrosion, and biological fouling. This is accomplished by injecting chemicals, including corrosion inhibitors and a biocide, into the system. Water treatment with dispersants maintains solids in solution, eliminating deposition onto metal surfaces. The service water surge tank has a nitrogen overpressure to prevent oxygen ingress. Biofouling organisms, corrosion products, debris and silt are insignificant due to the water treatment used in the system. The normal service water system is equipped with a corrosion coupon rack to monitor and trend corrosion rates of various system materials. The corrosion coupon rack is designed to simulate various piping and components in the system, operating at various flow rates and temperatures. The corrosion coupon monitoring results are all well within the limits established for the service water system and indicate good control of closed cooling water system chemistry. Therefore, periodic flushing of infrequently used cooling loops of this demineralized water system was not included in the RBS response to NRC GL 89-13 and is not necessary to manage the effects of aging on the RBS service water system.

Operation of the RBS normal service water system is consistent with the conditions evaluated in NUREG-1801, Section XI.M21A. Program Element 3, Parameters Monitored/Inspected, states, "For closed-cycle cooling water systems as defined by Generic Letter 89-13, EPRI 1007820 is used." Section 2 of EPRI 1007820, "Closed Cooling Water Chemistry Guideline," includes this definition of a closed loop: "A closed system has also been defined as 'one in which the water is circulated in a closed loop with negligible evaporation or exposure to the atmosphere.'" Section 2 also identifies in the follow statement that the RBS system operating mode is one that was considered in developing the guideline.

> There is also at least one nuclear plant with a hybrid design that operates as a closed loop only during normal operation. Under emergency or shutdown conditions, the flow is diverted through an open recirculating cooling tower.

The RBS system operation is consistent with this closed cooling water operation described in the EPRI report to which NUREG-1801, Section XI.M21A, refers for program guidance. The RBS update to the GL 89-13 response, dated October 28, 1998, identified that the normal service water system was converted to a closed-loop system. The RBS normal service water is operated in its closed-loop mode greater than approximately 99 percent of the time. The use of raw water from the standby service water basin during outages does not represent a significant

contamination source because the standby cooling tower basin is treated, monitored and periodically cleaned. The makeup source for the basin is water from a deep well; not raw water from a lake or river. Also, the vacuum breaker solenoids on the service water system are opened for less than one minute to introduce air into the system only during testing of the standby service water system during refueling outages. Following this refueling outage testing, corrosion inhibitor chemistry concentrations are normally returned to within specifications in less than 24 hours.

In response to discussions with inspectors during the NRC regional inspection, RBS is adding ongoing inspections of service water heat exchangers to license renewal commitments. The LRA changes identified below will add these inspections to the Periodic Surveillance and Preventive Maintenance Program. These additions include the safety-related service water heat exchangers that credit the Water Chemistry Control – Closed Loop Cooling Water Program. The inspections will check for fouling that could cause flow blockage. Even though the RBS system operation is consistent with the operating modes considered in development of the EPRI guidelines discussed above, the added heat exchanger inspections provide additional assurance that fouling that could cause flow blockage is not occurring in the RBS normal service water system.

The changes to LRA Section 3.3.2.1.14, Table 3.3.1, Table 3.3.2-10, Table 3.3.2-11, Table 3.3.2-14, and Sections A.1.34 and B.1.34 follow with additions underlined.

Add to Section 3.3.2.1.14, Chilled Water System:

Aging Management Programs

The following aging management programs manage the aging effects for the chilled water system components.

- Bolting Integrity
- Coating Integrity
- External Surfaces Monitoring
- Internal Surfaces in Miscellaneous Piping and Ducting Components
- Oil Analysis
- One-Time Inspection
- <u>Periodic Surveillance and Preventive Maintenance</u>
- Water Chemistry Control – Closed Treated Water Systems

Revise LRA Table 3.3.1 as follows:

Table 3.3.1: Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-50	Stainless steel, copper alloy, steel heat exchanger tubes exposed to closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801 for most components. Reduction of heat transfer of stainless steel and copper alloy heat exchanger tubes exposed to closed-cycle cooling water is managed by the Water Chemistry Control – Closed Treated Water Systems Program and the Periodic Surveillance and Preventive Maintenance Program. In the portions of the RBS service water system covered by NRC GL 89-13, reduction of heat transfer is managed by the Service Water Integrity Program. There are no steel heat exchanger tubes exposed to closed-cycle cooling water in the scope of license renewal.

Add new row to LRA Table 3.3.2-10 as follows:

Table 3.3.2-10: Standby Diesel Generator System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Heat exchanger (tubes)	Heat transfer	Copper alloy	Treated water (int)	Reduction of heat transfer	Periodic Surveillance and Preventive Maintenance	VII.C2.AP-205	3.3.1-50	E

Add new row to LRA Table 3.3.2-11 as follows:

Table 3.3.2-11: HPCS Diesel Generator System								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Program**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Heat exchanger (tubes)	Heat transfer	Copper alloy > 15% zinc (inhibited)	Treated water (int)	Reduction of heat transfer	Periodic Surveillance and Preventive Maintenance	VII.C2.AP-205	3.3.1-50	E

Add new row to LRA Table 3.3.2-14 as follows:

Table 3.3.2-14: Chilled Water System								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Program**	**NUREG-1801 Item**	**Table 1 Item**	**Notes**
Heat exchanger (tubes)	Heat transfer	Copper alloy	Treated water (int)	Reduction of heat transfer	Periodic Surveillance and Preventive Maintenance	VII.C2.AP-205	3.3.1-50	E

Revise LRA Appendix A.1.34, Periodic Surveillance and Preventive Maintenance Program, to add the following to the end of the list:

- Inspect the following heat exchanger surfaces exposed to normal service water for fouling and flow blockage:
  - EGT-E1A, B standby diesel generator jacket water coolers, at least once every ten years.
  - E22-ES001, HPCS diesel generator system, at least once every 12 years.
  - HVK-CHL1A, B, C. D, control building chillers, at least once every six years.

Add the following to the end of existing table in LRA Section B.1.34, Periodic Surveillance and Preventive Maintenance Program:

EGT-E1A, B standby diesel generator jacket water coolers	At least once every ten years, inspect the heat exchanger surfaces exposed to service water for fouling and flow blockage.
E22-ES001 high pressure core spray diesel generator heat exchanger	At least once every 12 years, inspect the heat exchanger surfaces exposed to service water for fouling and flow blockage.
HVK-CHL1A, B, C. D control building chillers	At least once every six years, inspect the heat exchanger surfaces exposed to service water for fouling and flow blockage.

Revise LRA Section B.1.34, Section 4, “Detection of Aging Effects,” as follows:

This program is credited with managing cracking, loss of material, reduction of heat transfer, and change in material properties for components fabricated from aluminum, stainless steel, carbon steel, copper alloy, and elastomers in environments of treated water (closed loop system), exhaust gas, lube oil, raw water, and waste water.