Question

RAI B.1.21-2 (Flow-Accelerated Corrosion)

Background

For the "detection of aging effects" program element, Section 4.8 of RBS EP 15 00007 cites procedure EN-DC-315, "Flow-Accelerated Corrosion [FAC] Program," as the basis for being consistent with the GALL Report AMP XI.M17. Procedure EN-DC-315 states that specific software programs (i.e., "CHECWORKS" and "FAC Manager Web Edition") shall be used in determining the remaining component life. Based on discussions during the AMP Audit breakout session, both software programs are classified as Level C, which does not require verification/validation activities. GALL Report AMP XI.M17 states that the FAC program is described in NSAC-202L and that components are suitable for continued service if the predicted wall thickness at the next scheduled inspection is greater than or equal to the minimum allowable wall thickness. NSAC-202L, Section 2, "Elements of an Effective FAC Program," provides recommendations for ensuring that appropriate quality assurance is applied, including properly documenting work. Entergy report EC-0000072133, "RF-19 Post-Outage Report," includes a signed output sheet from FAC Manager, which contains wall thickness data and the measured wear rate from each inspection.

Issue

For safety-related components, it is not clear to the staff that the remaining component life is being properly determined because the wear rate values are taken from Level C software (i.e., "CHECWORKS" and "FAC Manager Web Edition"), which does not require validation and verification activities. Although the FAC Manager output sheets are signed as prepared and verified, the determination of the wear rate values cannot be independently verified based on the information provided.

Request

Provide additional information to show that appropriate quality assurance has been applied to the calculated wear rates used in the determination of the schedule for inspection of safety-related components.

Response

Note: A previous response to RAI B.1.21-2 was submitted in letter RBG-47834, dated March 8, 2018. The following response is the same as the response in letter RBG-47834 except additional information regarding software validation has been provided in the 3rd paragraph below. The following response supersedes the previous response submitted in letter RBG-47834.

CHECWORKS and FAC Manager Web Edition (FMWE) are Level C software which is used for day-to-day support activities and whose loss or failure would not affect the immediate ability to operate the plant but could threaten the plant's long-term ability to operate. The Level C classification is appropriate because the software is not embedded in or integral to a safety-related (SR) structure, system or component (SSC), is not utilized in the design process of SR SSCs, is not embedded in or an integral part of a non-safety related (NSR) SSC used to support or maintain an important to safety SSC (e.g. surveillance, calibration, post-maintenance test), is not used to determine Technical Specification, NRC regulation/commitments or 10CFR50 compliance, and is

not used to calibrate or maintain maintenance and test equipment (M&TE) used on safety-related or Technical Specification SSCs.

Level C software does not require "verification," which consists of evaluating and analyzing products of each life cycle phase (e.g., requirements specification, design descriptions, code, and databases) through testing and reviews or audits to discover and correct deficiencies as early as possible. However, the CHECWORKS code was developed in accordance with the quality assurance policies of EPRI, which require a formal software plan and detailed program documentation. These policies also mandate that a list of program bugs be maintained. The FMWE code was developed in accordance with the quality assurance policies of Altran, which also require a formal testing plan, detailed program documentation, and a list of program bugs.

Level C software does require "validation," which is the final testing activity and ensures that the software installation and integration into the production environment is successful. The installation is performed in accordance with a documented plan or vendor instructions which may include sample program inputs and outputs for use in verifying installation. In accordance with the Entergy software quality assurance procedure, each time CHECWORKS or FMWE is revised, FAC personnel validate the revised software using test cases and test databases before the software is placed in production mode. The validation tests provide the appropriate quality assurance to ensure that component wear, wear rate, predicted thickness, and remaining service life are calculated consistently with NSAC-202L.

Predictive model CHECWORKS is just one of the tools used to determine inspection eligibility and priority. Selection of inspection locations for an outage is based on the following factors.

- previous inspection results
- CHECWORKS susceptibility ranking
- industry and plant-specific operating experience
- components selected to calibrate CHECWORKS
- components subject to off normal flow conditions, such as caused by a leaking valve
- susceptible non-modeled small bore piping that has not been inspected

Measurement of actual wall thickness during inspections is the primary tool used in the FAC Program to determine component wear. The measured wall thickness is used to determine wear rates, predicted thickness, and remaining service life in FAC Manager Web Edition (FMWE) according to the following steps.

- Initial thickness of a component is determined by ultrasonic inspection prior to the component being placed in service or in the first ultrasonic inspection during its service life. If an examination has not previously been performed on the component, the initial thickness is determined by reviewing the initial ultrasonic data for that component. The area of maximum wall thickness within the same region as the worn area is identified. If the thickness is greater than the nominal component wall thickness, the maximum wall thickness within the relevant area is used as the initial thickness. If that thickness is less than the nominal wall thickness, the nominal wall thickness is used as the initial thickness.
- The projected wear rate is calculated by dividing the wear by the time between measurements or the time between when the component was placed in service and the time of the measurement. Wear is the amount of material removed or lost from a components wall thickness since baseline or subsequent to being placed in service and time is the actual plant operating hours, although calendar hours may be used for conservatism.

- The remaining service life (RSL) is determined by subtracting the minimum acceptable wall thickness from the actual measured wall thickness, then dividing by the wear rate times a safety factor of 1.1.
- If the RSL of a component is greater than or equal to the number of hours in the next operating cycle, the component may be returned to service. If the component's RSL is greater than the number of hours in the next operating cycle but is less than the number of hours in the next two operating cycles, the component should be considered for re-inspection, repair or replacement during the next scheduled outage. If the component is acceptable for continued service, it shall be re-examined before, or during the cycle during which it is projected to wear to the minimum acceptable wall thickness.

Evaluation of wear rates, predicted thickness, and remaining service life is documented and reviewed by qualified FAC personnel or designated personnel qualified in accordance with the engineering calculation process. Therefore, appropriate quality assurance is applied to the calculated wear rates used in the determination of the schedule for inspection of safety-related components.