

XI.E5 FUSE HOLDERS

Program Description

The purpose of the aging management program (AMP) described herein is to provide reasonable assurance that the intended functions of the metallic clamps of fuse holders are maintained consistent with the current licensing basis through the period of extended operation.

Fuse holders (fuse blocks) are classified as a specialized type of terminal block because of the similarity in fuse holder design and construction to that of a terminal block. Fuse holders are typically constructed of blocks of rigid insulating material, such as phenolic resins. Metallic clamps (clips) are attached to the blocks to hold each end of the fuse. The clamps, which are typically made of copper, can be spring-loaded clips that allow the fuse ferrules or blades to slip in, or they can be bolt lugs, to which the fuse ends are bolted.

AMP XI.E1, "Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements," manages the aging of insulating material but not the metallic clamps of the fuse holders. The AMP for fuse holders (metallic clamps) needs to account for the following aging stressors if applicable: increased resistance of connection due to chemical contamination, corrosion, and oxidation or fatigue caused by ohmic heating, thermal cycling, electrical transients, frequent manipulation, or vibration. AMP XI.E1 is based on only a visual inspection of accessible cables and connections. Visual inspection is not sufficient to detect the aging effects from chemical contamination, corrosion, oxidation, fatigue, or vibration on the metallic clamps of the fuse holder.

Fuse holders that are within the scope of license renewal should be tested to provide an indication of the condition of the metallic clamps of the fuse holders. The specific type of test performed is determined prior to the initial test and is to be a proven test for detecting deterioration of metallic clamps of the fuse holders, such as thermography, contact resistance testing, or other appropriate testing justified in the application.

As stated in NUREG-1760, "Aging Assessment of Safety-Related Fuses Used in Low and Medium-Voltage Applications in Nuclear Power Plants," fuse holders experience a number of age-related failures. The major concern is that failures of a deteriorated cable system (cables, connections including fuse holders, and penetrations) might be induced during accident conditions. Since they are not subject to the environmental qualification requirements of 10 CFR 50.49, an AMP is required to manage the aging effects. This AMP ensures that fuse holders will perform their intended function for the period of extended operation.

Evaluation and Technical Basis

1. **Scope of Program:** This AMP manages fuse holders (metallic clamps) located outside of active devices that are considered susceptible to the following aging effects: increased resistance of connection due to chemical contamination, corrosion, and oxidation or fatigue caused by ohmic heating, thermal cycling, electrical transients, frequent manipulation, or vibration. Fuse holders inside an active device (e.g., switchgear, power supplies, power inverters, battery chargers, and circuit boards) are not within the scope of this AMP.
2. **Preventive Actions:** This is a condition monitoring program and no actions are taken as part of this program to prevent or mitigate aging degradation.

3. **Parameters Monitored/Inspected:** The metallic clamp portion of the fuse holder is tested to provide an indication of increased resistance of the connection due to chemical contamination, corrosion, and oxidation or fatigue caused by ohmic heating, thermal cycling, electrical transients, frequent manipulation or vibration.
4. **Detection of Aging Effects:** Fuse holders within the scope of license renewal are tested at least once every 10 years to provide an indication of the condition of the metallic clamp of the fuse holder. Testing may include thermography, contact resistance testing, or other appropriate testing methods. This is an adequate period to preclude failures of the fuse holders since experience has shown that aging degradation is a slow process. A 10-year testing interval provides two data points during a 20-year period, which can be used to characterize the degradation rate. The first tests for license renewal are to be completed prior to the period of extended operation.
5. **Monitoring and Trending:** Trending actions are not included as part of this AMP because the ability to trend test results is dependent on the specific type of test chosen. However, results that are trendable provide additional information on the rate of degradation.
6. **Acceptance Criteria:** The acceptance criteria for each test are defined by the specific type of test performed and the specific type of fuse holder tested. The metallic clamp of the fuse holder needs to be below the maximum allowed temperature for the application when thermography is used; otherwise, a low resistance value appropriate for the application when resistance measurement is used.
7. **Corrective Action:** Corrective actions are taken and an engineering evaluation is performed when the test acceptance criteria are not met in order to ensure that the intended functions of the fuse holders can be maintained consistent with the current licensing basis. Such an evaluation is to consider the significance of the test results, the operability of the component, the reportability of the event, the extent of the concern, the potential root causes for not meeting the test acceptance criteria, the corrective action necessary, and the likelihood of recurrence. As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.
8. **Confirmation Process:** As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process.
9. **Administrative Controls:** The administrative controls for this AMP provide for a formal review and approval process. As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the administrative controls.
10. **Operating Experience:** Operating experience has shown that loosening of fuse holders and corrosion of fuse clips are aging mechanisms that, if left unmanaged, can lead to a loss of electrical continuity function. Operating experience in NUREG-1760 documented fuse holder failures due to fatigue and recommends maintenance procedures be reviewed to minimize removal and reinsertion of fuses to de-energize components (as this can lead to degradation of the fuse holders).

This AMP considers the technical information and guidance provided in NUREG-1760, IEEE Std. 1205-2000, NRC IN 86-87, NRC IN 87-42, and NRC IN 91-78.

References

10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants*, Office of the Federal Register, National Archives and Records Administration, 2009.

IEEE standard 1205-2000, *IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Class 1E Equipment Used in Nuclear Power Generating Stations*.

NRC Information Notice 86-87, *Loss of Offsite Power Upon an Automatic Bus Transfer*, October 10, 1986.

NRC Information Notice 87-42, *Diesel Generator Fuse Contacts*, September 4, 1987.

NRC Information Notice 91-78, *Status Indication of Control Power for Circuit Breakers Used in Safety-Related Application*, November 28, 1991.

NUREG-1760, *Aging Assessment of Safety-Related Fuses Used in Low- and Medium-Voltage Applications in Nuclear Power Plants*, May 31, 2002.