

XI.E2 ELECTRICAL CABLES NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS USED IN INSTRUMENTATION CIRCUITS

Program Description

In most areas within a nuclear power plant, the actual ambient environments (e.g., temperature, radiation, or moisture) are less severe than the plant design environment. However, in a limited number of localized areas, the actual environments may be more severe than the plant design environment for those areas. Conductor insulation materials used in electrical cables may degrade more rapidly than expected in these adverse localized environments. An adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified service environment for the cable. An adverse variation in environment is significant if it could appreciably increase the rate of aging of a component or have an immediate adverse effect on operability.

Exposure of electrical cables to adverse localized environments caused by heat or radiation can result in reduced insulation resistance (IR). Reduced IR causes an increase in leakage currents between conductors and from individual conductors to ground. A reduction in IR is a concern for circuits with sensitive, low-level signals such as radiation monitoring and nuclear instrumentation since it may contribute to inaccuracies in instrument circuits.

The purpose of the aging management program described herein is to provide reasonable assurance that the intended functions of electrical cables that are not subject to the environmental qualification requirements of 10 CFR 50.49 and are used in instrumentation circuits with sensitive, low-level signals exposed to adverse localized environments caused by heat, radiation or moisture will be maintained consistent with the current licensing basis through the period of extended operation. This program considers the technical information and guidance provided in NUREG/CR-5643, IEEE Std. P1205, SAND96-0344, and EPRI TR-109619.

In this aging management program, calibration results or findings of surveillance testing programs are used to identify the existence of aging degradation. For example, when an instrumentation circuit is found to be out of calibration, additional evaluation of the circuit is performed.

This aging management program applies to high-range-radiation and neutron flux monitoring instrumentation cables in addition to other cables used in high voltage, low-level signal applications that are sensitive to reduction in insulation resistance. For these cables XI.E1 does not apply.

As stated in NUREG/CR-5643, "The major concern with cables is the performance of aged cable when it is exposed to accident conditions." The statements of consideration for the final license renewal rule (60 Fed. Reg. 22477) states, "The major concern is that failures of deteriorated cable systems (cables, connections, and penetrations) might be induced during accident conditions."

Enclosure 2

Evaluation and Technical Basis

1. **Scope of Program:** This program applies to electrical cables used in circuits with sensitive, high voltage, low-level signals such as radiation monitoring and nuclear instrumentation that are within the scope of license renewal.
2. **Preventive Actions:** No actions are taken as part of this program to prevent or mitigate aging degradation.
3. **Parameters Monitored/Inspected:** The parameters monitored are determined from the specific calibrations or surveillances performed and are based on the specific instrumentation circuit under surveillance or being calibrated, as documented in the surveillance procedures.
4. **Detection of Aging Effects:** Review of calibration results or findings of surveillance programs can provide an indication of the existence of aging effects by monitoring key parameters and providing data based on acceptance criteria related to instrumentation circuit performance. By reviewing the results obtained during normal calibration or surveillances, the applicants may detect severe aging degradation prior to the loss of the cable intended function. All calibration or surveillance results that fail to meet acceptance criteria will be reviewed for aging effects as soon as the results are available. The first reviews will be completed before the end of the initial 40-year license term and every 10 years thereafter.

In cases where cables are not part of calibration or surveillance program, a proven cable test for detecting deterioration of the insulation system (such as insulation resistance tests, time-domain reflectometry tests, or other testing judged to be effective in determining cable insulation condition) will be performed. The test frequency of these cables shall be determined by the applicant based on engineering evaluation not to exceed 10 years. The first test will be completed before the end of the initial 40-year license term.

5. **Monitoring and Trending:** Trending actions are not included as part of this program because the ability to trend test results is dependent on the specific type of test chosen. Although not a requirement, test results that are trendable provide additional information on the rate of degradation.
6. **Acceptance Criteria:** Calibration results or findings of surveillances are to be within the acceptance criteria, as set out in the surveillance procedures.
7. **Corrective Actions:** Corrective actions such as recalibration and circuit trouble-shooting are implemented when calibration or surveillance results or findings of surveillances do not meet the acceptance criteria. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address corrective actions.
8. **Confirmation Process:** As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process.
9. **Administrative Controls:** As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address administrative controls.

10. Operating Experience: Operating experience has identified a case where a change in temperature across high range radiation monitor cable in containment resulted in substantial change in the reading of the monitor. Changes in instrument calibration can be caused by degradation of the circuit cable and are a possible indication of electrical cable degradation.

The vast majority of site specific and industry wide operating experience regarding Neutron Flux Instrumentation Circuits is related to cable/connector issues inside of containment near the reactor vessel. There is comparatively far less operating experience in the other more benign areas of the plant.

References

EPRI TR-109619, *Guideline for the Management of Adverse Localized Equipment Environments*, Electric Power Research Institute, Palo Alto, CA, June 1999.

IEEE Std. P1205-2000, *IEEE Guide for Assessing, Monitoring and Mitigating Aging Effects on Class 1E Equipment Used in Nuclear Power Generating Stations*.

NUREG/CR-5643, *Insights Gained From Aging Research*, U. S. Nuclear Regulatory Commission, March 1992.

SAND96-0344, *Aging Management Guideline for Commercial Nuclear Power Plants - Electrical Cable and Terminations*, prepared by Sandia National Laboratories for the U.S. Department of Energy, September 1996.

NRC Information Notice 97-45, *Environmental Qualification Deficiency for Cables and Containment Penetration Pigtails*, U.S. Nuclear Regulatory Commission, July 2, 1997 and Supplement 1, February 17, 1998