

CHAPTER VI
ELECTRICAL COMPONENTS

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ELECTRICAL COMPONENTS

- A. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
- B. Equipment Subject to 10 CFR 50.49 Environmental Qualification Requirements

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A. ELECTRICAL CABLES AND CONNECTIONS NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

A.1 Conductor Insulation

- A.1.1 Electrical cables and connections exposed to an adverse localized environment caused by heat, radiation, or moisture
- A.1.2 Electrical cables used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance (IR) exposed to an adverse localized environment caused by heat, radiation, or moisture
- A.1.3 Inaccessible medium-voltage (2kV to 15kV) cables (e.g., installed in conduit or direct buried) exposed to an adverse localized environment caused by exposure to moisture and voltage

A.2 Connector Contacts

- A.2.1 Electrical connectors exposed to borated water leakage

A. ELECTRICAL CABLES AND CONNECTIONS NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Systems, Structures and Components

This section addresses electrical cables and connections that are not subject to the environmental qualification requirements of 10 CFR 50.49, and that are installed in power and instrumentation and control (I&C) applications. The power cables and connections addressed are low-voltage (<1000V) and medium-voltage (2kV to 15kV). High voltage (>15kV) power cables and connections have unique, specialized constructions and must be evaluated on an application specific basis.

Electrical cables and their required terminations (i.e., connections) are typically reviewed as a single commodity. The types of connections included in this review are splices, mechanical connectors, and terminal blocks. This common review is translated into program actions, which treat cables and connections in the same manner.

Electrical cables and connections that are in the plant's environmental qualification (EQ) program are addressed in VI.B.

System Interfaces

Electrical cables and connections functionally interface with all plant systems that rely on electric power or instrumentation and control. Electrical cables and connections also interface with and are supported by structural commodities (e.g., cable trays, conduit, cable trenches, cable troughs, duct banks, cable vaults and manholes) that are reviewed, as appropriate, in the Structures and Components Supports section.

VI Electrical Components
A. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
A.1-a A.1.1	Conductor insulation Conductor insulation for electrical cables and connections	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance, electrical failure / (Thermal/thermooxidative) degradation of organics, radiolysis and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation, moisture intrusion	Chapter XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No

VI Electrical Components

A. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
A.1-b A.1.2	Conductor insulation Conductor insulation for electrical cables used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance (IR)	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance, electrical failure / (Thermal/thermooxidative) degradation of organics, radiation-induced oxidation, moisture intrusion	Chapter XI.E2, "Electrical Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits"	No
A.1-c A.1.3	Conductor insulation Conductor insulation for inaccessible medium-voltage (2kV to 15kV) cables (e.g., installed in conduit or direct buried)	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by exposure to moisture and voltage	Formation of water trees, localized damage, leading to electrical failure (breakdown of insulation)/ Moisture intrusion, water trees	Chapter XI.E3, "Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No
A.2-a A.2.1	Connector contacts Connector contacts for electrical connectors exposed to borated water leakage	Various metals used for electrical contacts	Exposure to borated water leakage	Corrosion of connector contact surfaces / Intrusion of borated water	Chapter XI.M10, "Boric Acid Corrosion"	No

B. EQUIPMENT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

B.1 Equipment Subject to 10 CFR 50.49 Environmental Qualification Requirements

B.1.1 Electrical Equipment Subject to 10 CFR 50.49 Environmental Qualification Requirements

B. EQUIPMENT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Systems, Structures and Components

The Nuclear Regulatory Commission (NRC) has established nuclear station environmental qualification (EQ) requirements in 10 CFR Part 50 Appendix A, Criterion 4, and in 10 CFR 50.49. 10 CFR 50.49 specifically requires that an EQ program be established to demonstrate that certain electrical components located in harsh plant environments (i.e., those areas of the plant that could be subject to the harsh environmental effects of a loss of coolant accident [LOCA], high energy line breaks [HELBs] or post-LOCA radiation) are qualified to perform their safety function in those harsh environments after the effects of inservice aging. 10 CFR 50.49 requires that the effects of significant aging mechanisms be addressed as part of environmental qualification. Components in the EQ program have a qualified life, and the components are replaced at the end of that qualified life, if it is shorter than the current operating term. The qualified life may be extended by methods such as refurbishment or reanalysis, but the licensee is required by the EQ regulation (10 CFR 50.49) to replace the component when its qualified life has expired.

System Interfaces

Equipment subject to 10 CFR 50.49 environmental qualification requirements functionally interface with all plant systems that rely on electric power or instrumentation and control.

VI Electrical Components
B. Equipment Subject to 10 CFR 50.49 Environmental Qualification Requirements

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	Aging Management Program (AMP)	Further Evaluation
<p>B.1-a</p> <p>B.1.1</p>	<p>Equipment subject to 10 CFR 50.49 environmental qualification requirements</p> <p>Electrical equipment subject to 10 CFR 50.49 EQ requirements</p>	<p>Various polymeric and metallic materials</p>	<p>Adverse localized environment caused by heat, radiation, oxygen, moisture, or voltage</p>	<p>Various degradation/ Various mechanisms</p>	<p>EQ is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.4, "Environmental Qualification (EQ) of Electrical Equipment," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii).</p> <p>See Chapter X.E1, "Environmental Qualification (EQ) of Electric Components," of this report for meeting the requirements of 10 CFR 54.21(c)(1)(iii).</p>	<p>Yes, TLAA</p>

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