

AUDIT WORKSHEET
GALL REPORT AMP

PLANT: _____

LRA AMP: _____

REVIEWER: _____

GALL AMP: **XI.E6, Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements**

DATE: _____

| Program Element | Auditable GALL Criteria | Documentation of Audit Finding |
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| Program Description | A. Cable connections are used to connect cable conductors to other cables or electrical devices. Connections associated with cables within the scope of license renewal are part of this program. The most common types of connections used in nuclear power plants are splices (butt or bolted), crimp-type ring lugs, connectors, and terminal blocks. Most connections involve insulating material and metallic parts. This aging management program for electrical cable connections (metallic parts) account for the following aging stressors: thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation. | Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment: |
| “ | B. GALL XI.E1, “Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements,” manages the aging of insulating material but not the metallic parts of the electrical connections. GALL 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 thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation on the metallic parts of cable connections. | Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment: |
| “ | C. Circuits exposed to appreciable ohmic or ambient heating during operation may experience loosening related to repeated cycling of connected loads or of the ambient temperature | Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: |

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| | <p>environment. Different materials used in various cable system components can produce situations where stresses existing between these components change with repeated thermal cycling. For example, under loaded conditions, appreciable ohmic heating may raise the temperature of a compression termination and cable conductor well above the ambient temperature, thereby causing thermal expansion of both components. Different thermal expansion coefficients may alter mechanical stresses between the components so that the termination may tighten on the conductor. When the load or current is reduced, the affected components cool and contract. Repeated cycling in this fashion can produce loosening of the termination under ambient conditions, and may lead to high electrical resistance joints or eventual separation to compression-type terminations. Threaded connectors, splices, and terminal blocks may loosen if subjected to significant thermally induced stress and cycling.</p> | <p>Comment:</p> |
| “ | <p>D. Cable connections within the scope of license renewal should be tested to provide an indication of the integrity of the cable connections. The specific type of test performed will be determined prior to the initial test, and is to be a proven test for detecting loose connections, such as thermography, contact resistance testing, or other appropriate testing justified in the application. This program, as described, can be thought of as a sampling program. The following factors are considered for sampling: application (high, medium and low voltage), circuit loading, and location (high temperature, high humidity, vibration, etc.). The technical basis for the sample selections is documented. If an unacceptable condition or situation is identified in the selected sample, a determination is made as to whether the same condition or situation is applicable to other connections not tested.</p> | <p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria:</p> <p>Comment:</p> |
| “ | <p>E. SAND 96-0344, “Aging Management Guidelines for Electrical Cable and Terminations,” indicated loose terminations were</p> | <p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria:</p> |

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| | <p>identified by several plants. 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 the connections are not subject to the environmental qualification requirements of 10 CFR 50.49, an aging management program is required to manage the aging effects. This program will ensure that electrical cable connections will perform their intended function for the period of extended operation.</p> | <p>Comment:</p> |
| <p>1. Scope of Program</p> | <p>A. Connections associated with cables in scope of license renewal are part of this program, regardless of their association with active or passive components.</p> | <p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria:</p> <p>Comment</p> |
| <p>2. Preventive Actions</p> | <p>A. No actions are taken as part of this program to prevent or mitigate aging degradation.</p> | <p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria:</p> <p>Comment:</p> |
| <p>3. Parameters Monitored/ Inspected</p> | <p>A. This program will focus on the metallic parts of the connection. The monitoring includes loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation. A representative sample of electrical cable connections is tested. The following factors are to be considered for sampling: application (high, medium and low voltage), circuit loading, and location (high temperature, high humidity, vibration, etc.). The technical basis for the sample selected is to be documented.</p> | <p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria:</p> <p>Comment:</p> |

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| 4. Detection of Aging Effects | A. Electrical connections within the scope of license renewal will be tested at least once every 10 years. Testing may include thermography, contact resistance testing, or other appropriate testing methods. This is an adequate period to preclude failures of the electrical connections since experience has shown that aging degradation is a slow process. A 10-year testing interval will provide 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 before the period of extended operation. | Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment: |
| 5. Monitoring and Trending | A. 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. However, test results that are trendable provide additional information on the rate of degradation. | Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment: |
| 6. Acceptance Criteria | A. The acceptance criteria for each test are defined by the specific type of test performed and the specific type of cable connections tested. | Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment: |
| 7. Corrective Actions | A. An engineering evaluation is performed when the test acceptance criteria are not met in order to ensure that the intended functions of the cable connections 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. When an unacceptable condition or situation is identified, a determination is made on whether the same condition or situation is applicable to other in-scope cable | Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment: |

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| | connections not tested. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions. | |
| 8. Confirmation Process | A. 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. | <p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p> |
| 9. Administrative Controls | A. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the administrative controls. | <p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p> |
| 10. Operating Experience | A. Operating experience has shown that loosening of connections and corrosion of connections are aging mechanisms that, if left unmanaged, could lead to a loss of electrical continuity and potential arcing or fire. | <p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p> |

EXCEPTIONS

| Item Number | Program Elements | LRA Exception Description | Basis for Accepting Exception | Documents Reviewed (Identifier, Para.# and/or Page #) |
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| 1. | | | | |
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ENHANCEMENTS

| Item Number | Program Elements | LRA Enhancement Description | Basis for Accepting Enhancement | Documents Reviewed (Identifier, Para.# and/or Page #) |
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| 2. | | | | |
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DOCUMENT REVIEWED DURING AUDIT

| Document Number | Identifier (number) | Title | Revision and/or Date |
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| 1. | | | |
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