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1. Scope of Program: This AMP applies to all inaccessible or below grade (e.g., installed in buried conduit, embedded raceway, cable trenches, cable troughs, duct banks, vaults, manholes, or direct buried installations) low voltage power cable within the scope of SLR exposed to adverse localized environments primarily due to significant moisture.

Significant moisture is defined as exposure to moisture that lasts more than a few days (i.e., long term wetting or submergence over a continuous period). Cable wetting or submergence that occurs for a limited time as demonstrated by either automatic or passive drainage is not considered an adverse localized environment for this AMP.

In-scope inaccessible low voltage power cable splices subjected to wetting or submergence are included within the scope of this program. Cables designed for continuous wetting or submergence are also included in this AMP as a onetime visual inspection with additional periodic tests and visual inspections determined by the test/inspection results and industry and plant specific aging degradation operating experience with the applicable cable electrical insulation.

2. Preventive Actions: This is a condition monitoring program. However, periodic actions are taken to prevent inaccessible low voltage power cable from being exposed to significant moisture, such as identifying and inspecting in-scope accessible cable conduit ends and cable manholes/vaults for water collection, and draining the water, as needed.

The inspection frequency for water collection in manholes/vaults is established and performed based on plant-specific operating experience with cable wetting or submergence. The inspections are performed periodically based on water accumulation over time. The periodic inspection occurs at least once annually with the first inspection for SLR completed prior to the subsequent period of extended operation. The annual inspection frequency is consistent with inspection procedure 71111.06.

Inspections are performed after event driven occurrences, such as heavy rain, rapid thawing of ice and snow, or flooding. Plant specific parameters are established for the initiation of an event driven inspection. Inspections include direct indication that cables are not ~~wetted or~~ submerged, and that cable/splices and cable support structures are intact. Dewatering systems (e.g., sump pumps and passive drains) and associated alarms are inspected and their operation verified periodically. The periodic Inspection includes documentation that either automatic or passive drainage systems, or manually pumping of manholes or vaults is effective in preventing inaccessible cable exposure to significant moisture.

If water is found during inspection (i.e., cable exposed to significant moisture), corrective actions are taken to keep the cable dry and to assess cable degradation (i.e., through visual inspection and/or cable testing). The aging management of the physical structure, including cable support structures, of cable vaults/manholes is managed by Generic Aging Lessons Learned for Subsequent Licensing Renewal (GALL-SLR) Report AMP XI.S6.

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3. Parameters Monitored or Inspected: Visual ~~i~~inspection for water collection in manholes/vaults is performed based on plant-specific operating experience with water accumulation over time. Inaccessible or below grade low voltage power cables within the scope of SLR exposed to significant moisture are evaluated to determine if testing is prudent for monitoring the condition of the cable's insulation system. Cable insulation systems that are known to degrade with continuous exposure to moisture (Vulkene and Raychem XLPE) are tested to determine the condition of the electrical conductor insulation. If local operating experience for other cable insulation types points to degradation from exposure to significant moisture, that specific insulation type is also tested to determine the condition of the conductor electrical insulation. The specific type of test(s) to be used is a proven technique capable of detecting reduced insulation resistance of the cable's insulation system due to wetting or submergence.

4. Detection of Aging Effects: For inaccessible low voltage power cables exposed to significant moisture where testing is required, ~~test frequencies are adjusted based on test results (including trending of degradation where applicable) and plant specific operating experience. Cable testing occurs at least once every 6 years. The first tests for SLR are to be completed~~ a one-time test is performed prior to the subsequent period of extended operation ~~with tests performed at least once every 6 years thereafter~~. This is ~~an~~ adequate ~~period~~ to monitor performance of the cable and take appropriate corrective actions since experience has shown that ~~although~~ aging degradation is a slow process~~, aging degradation could be significant~~.

The specific type of test performed is determined prior to the initial test, and is to be a proven test for detecting aging degradation of the cable electrical insulation system (e.g., the selected test is applicable to the specific cable construction: shielded and nonshielded, and the insulation material under test).

Tests may include combinations of in-situ or laboratory; electrical, physical, or chemical testing. Testing may include visual inspection and testing of cables or testing of coupons or abandoned or removed cables subjected to the same environment and exposed to the same or bounding inservice environment. A plant specific inaccessible low voltage test matrix is developed to document inspections, determination of whether testing is required, test methods, and acceptance criteria applicable to the applicant's in-scope inaccessible low voltage power cable types.

For a large installed number of low voltage power cables exposed to significant moisture where testing is required, a sample test methodology may be employed. A sample size of 20% of the population not to exceed 25 cables shall be used for selecting inaccessible low voltage power cables to test. Inaccessible low voltage power cable factors are considered for sampling (e.g., voltage level, cable construction, cable type, insulation material, and location). 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 inaccessible low voltage power cable not tested and whether the tested sample

population should be expanded. The corrective action program is used to evaluate the condition and determine appropriate corrective action.

5. Monitoring and Trending: Trending actions are not included as part of this AMP because the ability to trend visual inspection and test results is dependent on the test or visual inspection program selected. However, condition monitoring cable test and visual inspection results utilizing the same visual inspection and test methods that are trendable and repeatable provide additional information on the rate of cable or connection insulation degradation.

6. Acceptance Criteria: The acceptance criteria for each test or inspection are defined by the specific type of test performed and the specific cable tested. Acceptance criteria for inspections of manholes are defined by the direct indication that cable support structures are intact and cables are not ~~submerged~~subject to significant moisture. Dewatering systems (e.g., sump pumps and drains) and associated alarms are inspected and their operation verified.

7. Corrective Actions: Results that do not meet the acceptance criteria are addressed as conditions adverse to quality or significant conditions adverse to quality under those specific portions of the quality assurance (QA) program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the corrective actions element of this AMP for both safety-related and nonsafety-related structures and components within the scope of this program.

Unacceptable test results and visual indications of electrical insulation material abnormalities are subject to an engineering evaluation. Such an evaluation considers the age and operating environment of the component as well as the severity of the abnormality and whether such an abnormality has previously been correlated to degradation of cable or connection electrical insulation. When an unacceptable condition or situation is identified, a determination is made as to whether the same condition or situation is applicable to additional in-scope accessible and inaccessible cables or connections (extent of condition).

Corrective actions may include, but are not limited to, installation of permanent drainage systems, (e.g., sump pumps, passive drainage systems and alarms), more frequent cable testing or inspections, repair (e.g., replace degraded cable sections), replacement of the affected cable, and root cause assessment of cable failures including forensic evaluations as applicable, with the AMP enhanced as necessary consistent with the discussion in Appendix B of the GALL-SLR Report.

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8. Confirmation Process: The confirmation process is addressed through those specific portions of the QA program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the confirmation process element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

9. Administrative Controls: Administrative controls are addressed through the QA program that is used to meet the requirements of 10 CFR Part 50, Appendix B, associated with managing the effects of aging. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the administrative controls element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

10. Operating Experience: Operating experience has shown that some electrical insulation materials undergo accelerated degradation when subjected to significant moisture~~are susceptible water intrusion failures including water tree formation~~. Aging effects of reduced insulation resistance due to other aging mechanisms and effects may also result in a decrease in the dielectric strength of the conductor insulation. Minimizing exposure to moisture mitigates the potential for the development of reduced insulation resistance.

The U.S. Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2007-~~0~~01 concerning inaccessible or below grade cables to (a) inform licensees that the failure of certain power cables can affect the functionality of multiple accident mitigation systems or cause plant transients and (b) gather information from licensees on the monitoring of inaccessible or below grade power cable failures for all cables that are within the scope of the Maintenance Rule. The data obtained from the GL responses show an increasing trend of cable failures. The GL 2007-01 summary report noted that the predominant factor contributing to cable failures at NPPs was due to moisture intrusion/submergence. These cables are failing within the plants' 40-year initial licensing period.

The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience, consistent with the discussion in Appendix B of the GALL-SLR Report.

This AMP considers the technical information and generic communication guidance provided in ~~RG 1.218,~~ NUREG/CR–5643; IEEE Std. 1205-2014; EPRI 109619; EPRI 103834-P1-2; NRC IN 2002-12; NRC IN 2010-26~~:~~ NRC IN 1986-49; NRC GL 2007-01; NRC GL 2007-01 Summary Report; NRC Inspection Procedure, Attachment 71111.06, NRC Inspection Procedure, Attachment 71111.01; RG 1.211~~,~~; RG 1.218; and NUREG/CR–7000.