AMP 212 ELECTRICAL ENCLOSURES NOT SUBJECT TO ENVIRONMENTAL QUALIFICATION REQUIREMENTS (VERSION 2020)

Programme Description

The purpose of this ageing management programme (AMP) is to provide for internal and external inspection of electrical enclosures (e.g. panels, distribution cabinets including switchgears and local control boxes) to identify age-related degradation of the metallic structures and polymeric and elastomeric materials of these components.

Electrical Enclosures are passive mechanical components which support electrical and I&C equipment mounted onto or inside them. An enclosure is a surrounding case or housing used to protect the contained conductors and prevent personnel from accidently contacting live parts [1]. These enclosures also provide the segregation and fire protection where many groups of components are installed. The enclosure may also have an environmental barrier to protect internal electrical equipment and electrical connections.

This programme does not manage the ageing effects on external structural supports and anchor bolts. The information for managing ageing of external structural supports and anchor bolts are described in AMP 306.

Usually, electrical and I&C maintenance personnel are performing the inspection of electrical enclosures during normal maintenance activities together with the active components; therefore, this AMP is considered an electrical and I&C programme rather than a civil engineering one.

Visual inspection provides reasonable assurance that electrical enclosures will perform their intended function. by detecting ageing degradation effects (i.e., loss of preload, loss of material, or loss of sealing function) and taking appropriate corrective actions.

Electrical enclosures covered by this AMP are not subject to environmental qualification requirements, therefore this AMP is required to manage the ageing effects.

Evaluation and Technical Basis

1. Scope of the ageing management programme based on understanding ageing:

This AMP manages the age-related degradation effects on electrical enclosures that are passive mechanical supporting components of active electrical and I&C equipment which are mounted onto or inside electrical enclosures.

1. Preventive actions to minimize and control ageing degradation:

This is a condition monitoring programme and no direct actions are taken as part of this programme to prevent ageing degradation. However, maintaining the environmental conditions specified in the design of certain electrical enclosures and avoidance of harmful environmental effects (e.g., moisture, high temperature, and dust contamination) can be evaluated as preventive steps.

1. Detection of ageing effects:

The potential ageing mechanisms and effects for carbon steel and low alloy steel constructions and construction elements of electrical equipment elements are as follows.

* Loss of material due to corrosion (general pitting and crevice corrosion) or wear.
* Loss of preload (e.g., due to self-loosening of bolts).
* Loss of sealing function (e.g., deterioration of elastomeric seals, gaskets, moisture barriers) of caulking, flashing, and other sealants.

Internal and outer surfaces of electrical enclosures are visually inspected for ageing degradation. The frequency of inspection is determined by the type of electrical enclosure and operating experience (e.g., past inspection results).

Visual inspection will identify indirect indicators of elastomer and flexible polymer hardening or loss of strength, including the presence of surface cracking, crazing, discoloration, and, for elastomers with internal reinforcement, the exposure of reinforcing fibers, mesh, or underlying metal. Visual inspections cover 100 percent of accessible component surfaces. Visual inspection will identify direct indicators of loss of material due to wear to include dimension change (e.g. “ballooning” and “necking”), scuffing, and, for flexible polymeric materials with internal reinforcement, the exposure of reinforcing fibers, mesh, or underlying metal. Manual or physical manipulation can be used to augment visual inspection to confirm the absence of hardening or loss of strength for elastomers and flexible polymeric materials (e.g., heating, ventilation, and air conditioning flexible connectors) where appropriate. The sample size for manipulation is at least 10 percent of available surface area.

1. Monitoring and trending of ageing effects:

Trending actions are not included as part of this AMP because the ability to trend inspection results is limited.

1. Mitigating ageing effects:

This programme is a condition monitoring programme. This programme has no specific operations, maintenance, repair or replacement mitigation aspects.

1. Acceptance criteria:

Any indication or relevant conditions of degradation may be evaluated for acceptance in accordance with the pertinent governing requirements or guidance documents or design specifications especially for temperature limits. Examination results and flaws that exceed the acceptance criteria in the pertinent governing requirements or guidance documents may require repair or replacement activities, or further evaluation to demonstrate that the component will continue to perform its intended function.

Electric Power Research Institute technical reports [2,3], provide general guidance for evaluation of materials and criteria for their acceptance when performing visual/tactile inspections.

1. Corrective actions:

Actions are taken by the responsible technical or operational organization, based on the ageing management experience, to mitigate or, in specific cases, to eliminate the degradation. Examples of corrective actions are shown below.

* Repair of corroded area (removal of corrosion products and recoating as applicable
* Tighten hardware (e.g., bolts)
* Replacement of elastomeric components (seal element)
* Repair of cooling or ventilation system/mechanism of enclosure.

1. Operating experience feedback and feedback of research and development results:

This AMP addresses the industry-wide generic experience. Relevant plant-specific operating experience is considered in the development of the plant AMP to ensure the AMP is adequate for the plant. The plant implements a feedback process to periodically evaluate plant and industry-wide operating experience and research and development (R&D) results, and, as necessary, either modifies the plant AMP or takes additional actions (e.g. develop a new plant-specific AMP) to ensure the continued effectiveness of ageing management.

Operating experience has identified internal and external age-related degradation of electrical enclosures including age-related degradation of the metallic structures and polymeric and elastomeric materials of these components [4].

At the time when this AMP was produced, no relevant R&D was identified

1. Quality management:

Site quality assurance procedures, review and approval processes, and administrative controls are implemented in accordance with the different national regulatory requirements, e.g., [5].

References

1. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, IEEE Standard for Metal-Enclosed Bus, IEEE Std. C37.23-2003, April 2004.
2. ELECTRIC POWER RESEARCH INSTITUTE, Aging Assessment Field Guide, EPRI TR- 1007933, EPRI, Palo Alto, CA, December 2003.
3. ELECTRIC POWER RESEARCH INSTITUTE, Aging Identification and Assessment Checklist, EPRI TR-1009743, EPRI, Palo Alto, CA, August 2004.
4. UNITED STATES NUCLEAR REGULATORY COMMISSION, Information Notice 98-36, “Inadequate or Poorly Controlled Non-Safety-Related Maintenance Activities Unnecessarily Challenged Safety Systems,” U.S. Nuclear Regulatory Commission, 1998.
5. UNITED STATES NUCLEAR REGULATORY COMMISSION, 10 CFR Part 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants, Office of the Federal Register, National Archives and Records Administration, USNRC, 2015.