

XI.M38 INSPECTION OF INTERNAL SURFACES IN MISCELLANEOUS PIPING AND DUCTING COMPONENTS

Program Description

The program consists of inspections of the internal surfaces of metallic piping, piping components, ducting, polymeric components, and other components that are exposed to air-indoor uncontrolled, air outdoor, condensation, and any water system other than open-cycle cooling water system (XI.M20), closed treated water system (XI.M21A), and fire water system (XI.M27). These internal inspections are performed during the periodic system and component surveillances or during the performance of maintenance activities when the surfaces are made accessible for visual inspection. The program includes visual inspections to ensure that existing environmental conditions are not causing material degradation that could result in a loss of component intended functions. For certain materials, such as polymers, physical manipulation or pressurization (e.g., hydrotesting) to detect hardening or loss of strength should be used to augment the visual examinations conducted under this program. If visual inspection of internal surfaces is not possible, then the applicant needs to provide a plant-specific program.

This program is not intended for use on piping and ducts where repetitive failures have occurred from loss of material that resulted in loss of intended function. If operating experience indicates that there have been repetitive failures caused by loss of material, a plant-specific program will be required. Following a failure, this program may be used if the failed material is replaced by one that is more corrosion-resistant in the environment of interest.

Evaluation and Technical Basis

1. **Scope of Program:** For metallic components, the program calls for the visual inspection of the internal surface of in-scope components that are not included in other aging management programs for loss of material. For metallic components with polymeric liners or for polymeric and elastomeric components, the program includes visual inspections of the internal polymer surfaces when coupled with additional augmented techniques, such as manipulation or pressurization. This program also includes metallic piping with or without polymeric linings, piping elements, ducting, and components in an internal environment. The program also calls for visual inspection and monitors the internal surfaces of polymeric and elastomeric components in mechanical systems for hardening and loss of strength, cracking, and for loss of material due to wear. The program manages the effects of aging of polymer materials in all environments to which these materials are exposed. Inspections are performed when the internal surfaces are accessible during the performance of periodic surveillances or during maintenance activities or scheduled outages. This program is not intended for piping and ducts where failures have occurred from loss of material from corrosion.
2. **Preventive Actions:** This program is a condition monitoring program to detect signs of degradation and does not provide guidance for prevention.
3. **Parameters Monitored/Inspected:** Parameters monitored or inspected include visible evidence of loss of material in metallic components.

This program manages loss of material and possible changes in material properties. This program monitors for evidence of surface discontinuities. For changes in material properties,

the visual examinations are supplemented, so changes in the properties are readily observable.

Examples of inspection parameters for metallic components include the following:

- corrosion and material parameters wastage (loss of material)
- leakage from or onto internal surfaces (loss of material)
- worn, flaking, or oxide-coated surfaces (loss of material)

Examples of inspection parameters for polymers are as follows:

- surface cracking, crazing, scuffing, and dimensional change (e.g., “ballooning” and “necking”)
- discoloration
- exposure of internal reinforcement for reinforced elastomers
- hardening as evidenced by a loss of suppleness during manipulation where the component and material are appropriate to manipulation

4. **Detection of Aging Effects:** Visual and mechanical inspections conducted under this program are opportunistic in nature; they are conducted whenever piping or ducting are opened for any reason. Visual inspections should include all accessible surfaces. Unless otherwise required (e.g., by the ASME code) all inspections should be carried out using plant-specific procedures by inspectors qualified through plant specific programs. The inspection procedures utilized must be capable of detecting the aging effect(s) under consideration. These inspections provide for the detection of aging effects prior to the loss of component function. Visual inspection of flexible polymeric components is performed whenever the component surface is accessible. Visual inspection can provide indirect indicators of the presence of surface cracking, crazing, and discoloration. For elastomers with internal reinforcement, visual inspection can detect the exposure of reinforcing fibers, mesh, or underlying metal. Visual and tactile inspections are performed when the internal surfaces become accessible during the performance of periodic surveillances or during maintenance activities or scheduled outages. Visual inspection provides direct indicators of loss of material due to wear, including dimensional change, scuffing, and the exposure of reinforcing fibers, mesh, or underlying metal for flexible polymeric materials with internal reinforcement.

Manual or physical manipulation of flexible polymeric components is used to augment visual inspection, where appropriate, to assess loss of material or strength. The sample size for manipulation is at least 10 percent of available surface area, including visually identified suspect areas. For flexible polymeric materials, hardening, loss of strength, or loss of material due to wear is expected to be detectable prior to any loss of intended function.

5. **Monitoring and Trending:** The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program uses standardized monitoring and trending activities to track degradation. Deficiencies are documented using approved processes and procedures such

that results can be trended. However, the program does not include formal trending. Inspections are performed at frequencies identified in Element 4, Detection of Aging Effects.

6. **Acceptance Criteria:** For each component/aging effect combination, the acceptance criteria are defined to ensure that the need for corrective actions is identified before loss of intended functions. For metallic surfaces, any indications of relevant degradation detected are evaluated. For stainless steel surfaces, a clean, shiny surface is expected. Discoloration may indicate the loss of material on the stainless steel surface. Any abnormal surface condition may be an indication of an aging effect for metals.

For flexible polymers, a uniform surface texture and uniform color with no unanticipated dimensional change is expected. Any abnormal surface condition may be an indication of an aging effect for metals and for polymers. For flexible materials to be considered acceptable, the inspection results should indicate that the flexible polymer material is in "as new" condition (e.g., the hardness, flexibility, physical dimensions, and color of the material are unchanged from when the material was new). Cracks should be absent within the material. For rigid polymers, surface changes affecting performance, such as erosion, cracking, crazing, checking, and chalks, are subject to further investigation.

Acceptance criteria include design standards, procedural requirements, current licensing basis, industry codes or standards, and engineering evaluation.

7. **Corrective Actions:** The site corrective actions program, quality assurance procedures, site review and approval process, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. As discussed in the Appendix for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions, confirmation process, and administrative controls.
8. **Confirmation Process:** As discussed in the GALL Report, the staff finds the requirements 10 CFR Part 50, Appendix B, acceptable to address the confirmation process.
9. **Administrative Controls:** As discussed in the GALL Report, the staff finds the requirements 10 CFR Part 50, Appendix B, acceptable to address the administrative controls.
10. **Operating Experience:** Inspections of internal surfaces during the performance of periodic surveillance and maintenance activities have been in effect at many utilities in support of plant component reliability programs. These activities have proven effective in maintaining the material condition of plant systems, structures, and components.

The elements that comprise these inspections (e.g., the scope of the inspections and inspection techniques) are consistent with industry practice and staff expectations. However, because the inspection frequency is plant-specific and depends on the plant operating experience, the applicant's plant-specific operating experience or applicable generic operating experience is further evaluated for the period of extended operation. The applicant evaluates recent operating experience and provides objective evidence to support the conclusion that the effects of aging are adequately managed.

References

10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants*, Office of the Federal Register, National Archives and Records Administration, 2009.

EPRI Technical Report 1007933, *Aging Assessment Field Guide*, December 2003.

EPRI Technical Report 1009743, *Aging Identification and Assessment Checklist*, August 27, 2004.

INPO Good Practice TS-413, *Use of System Engineers*, INPO 85-033, May 18, 1988.