## **AMP 135 INSPECTION OF INTERNAL SURFACES IN MISCELLANEOUS PIPING AND DUCTING COMPONENTS** **(VERSION 2020)**

## **Programme Description**

## The programme consists of inspections of the internal surfaces of metallic piping, piping components, ducting, heat exchangers, elastomeric and polymeric components, and other components that are exposed to air-indoor uncontrolled, air outdoor, air with borated water leakage, condensation, moist air, diesel exhaust, and any water system other than AMP 124, AMP 117 and AMP 131. 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 programme includes visual inspections, and when appropriate surface examinations, 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 are used to augment the visual examinations conducted under this programme. This programme may also be used to manage cracking due to stress corrosion cracking (SCC) in aluminium and stainless steel (SS) components exposed to aqueous solutios and air enviroments containing halides. If visual inspection of internal surfaces is not possible, then the applicant needs to provide a plant-specific programme.

## This programme is not intended for use on piping and ducts where repetitive failures have occurred. Repetitive failures are defined as failures with the same ageing mechanism in which the ageing effect resulted in loss of intended function (e.g., one per refueling outage cycle that has occurred over three or more sequential or nonsequential cycles for a 10-year OE search, or two or more sequential or nonsequential cycles for a 5-year OE search). If operating experience indicates that there have been repetitive failures caused by loss of material, a plant-specific programme will be required. Following a failure, this programme may be used again 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 the ageing management programme based on understanding ageing:***

## For metallic components, the programme calls for the visual inspection of the internal surface of in-scope components that are not included in other ageing management programmes for loss of material. For metallic components with polymeric liners or for polymeric and elastomeric components, the programme includes visual inspections of the internal polymer surfaces when coupled with additional augmented techniques, such as manipulation or pressurization. This programme also includes metallic piping with or without polymeric linings, piping elements, ducting, heat exchanger components and components in an internal environment. The programme 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 programme manages the effects of ageing 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 programme is not intended for piping and ducts where failures have occurred from loss of material from corrosion.

For situations in which the material and environment combinations are similar for the internal and external surfaces such that the external surface condition is representative of the internal surface condition, external inspections of components may be credited for managing: (a) loss of material from internal surfaces of metallic and cementitious components and (b) loss of material, cracking, and change in material properties from the internal surfaces of polymeric components. When credited, the programme describes the component’s internal environment and the credited external component’s environment inspected and provides the basis to justify that the external and internal surface condition and environment are sufficiently similar.

1. ***Preventive actions to minimize and control ageing degradation:***

This programme is a condition monitoring programme and does not contain any preventive actions.

1. ***Detection of ageing effects:***

Visual and mechanical (e.g., involving manipulation or pressurization of elastomers) inspections conducted under this programme are opportunistic in nature; they are conducted whenever piping, heat exchangers or ducting are opened for any reason. It is possible that opportunistic inspections might not be available to manage one or more possible combinations of material-environment-ageing effect for the components included in the scope of the programme. Therefore a minimum number of inspections is needed at least every 10 years. For example, License Renewal Interim Staff Guidance LR-ISG-2012-02 [1] and Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report [2] provide different approaches.

Internal visual inspections used to assess loss of material are capable of detecting surface irregularities that could be indicative of an unexpected level of degradation due to corrosion and corrosion production deposition. Where such irregularities are detected for steel components exposed to raw water, raw water (potable), or waste water, follow-up volumetric examinations could be performed.

On the other hand, different options are given in GALL-SLR Report [2] to implement periodic visual inspections or surface examinations when managing cracks in SS and aluminium components.

To determine the condition of internal surfaces of buried and underground piping, inspections of the interior surfaces of accessible piping may be credited if the accessible and buried or underground component material, environment, and ageing effects are similar.

When inspections of the interior surfaces of accessible components with similar material, environment, and ageing effects as the interior surfaces of buried or underground piping are not conducted, the sample population will be inspected using volumetric or internal visual inspections capable of detecting loss of material on the internal surfaces of the buried or underground piping.

Visual inspections includes all accessible surfaces. Unless otherwise required (e.g., by the ASME code) all inspections are carried out using plant-specific procedures by inspectors qualified through plant-specific programmes. The inspection procedures utilized are capable of detecting the ageing effect(s) under consideration. These inspections provide for the detection of ageing 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.

1. ***Monitoring and trending of ageing effects:***

This programme manages loss of material, cracking, reduction of heat transfer due to fouling, hardening or loss of strength of elastomeric components, and flow blockage. Parameters monitored or inspected include visible evidence of loss of material in metallic components. This programme manages loss of material and possible changes in material properties. This programme monitors for evidence of surface discontinuities. For changes in material properties, the visual examinations are supplemented, so changes in the properties are readily observable.

Periodic surface examinations could be conducted if this programme is being used to manage cracking in SS or aluminium components. Visual inspections for leakage or surface cracks are an acceptable alternative to conducting surface examinations to detect cracking if it has been determined that cracks will be detected prior to challenging the structural integrity or intended function of the component.

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);

## Cracking due to stress corrosion cracking;

## Debris accumulation on heat exchanger tube surfaces;

## Accumulation of particle fouling, biofouling, or macro fouling.

## Examples of inspection parameters for polymers are as follows:

## Surface cracking, crazing, scuffing, loss of sealing and dimensional change (e.g. 'ballooning” and “necking”);

## Loss of wall thickness;

## 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.

Examples of inspection parameters for cementitious materials include:

## Spalling;

## Scaling;

## Cacking.

## This programme 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 programme does not include formal trending.

1. ***Mitigating ageing effects:***

This programme is a condition monitoring programme and does not contain any mitigating actions.

1. ***Acceptance criteria:***

For each component/ageing effect combination, the acceptance criteria are defined to ensure that the need for corrective actions is identified before loss of intended functions [3-5]. 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 ageing 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 ageing effect for metals and for polymers. For flexible materials to be considered acceptable, the inspection results indicates 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 are absent within the material. For rigid polymers, surface changes affecting performance, such as erosion, cracking, crazing, , and chalking, are subject to further investigation. Acceptance criteria include design standards, procedural requirements, design basis, industry codes or standards, and engineering evaluation.

1. ***Corrective actions:***

Results that do not meet the acceptance criteria are addressed in the site corrective action programme. The site corrective actions programme, quality assurance procedures, site review and approval process, and administrative controls are implemented in conformance with the pertinent governing requirements or guidance documents when indications or relevant conditions of degradation can not be demonstrated to be acceptable.

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 the ageing management.

At the time when this AMP was produced, no relevant Operating Experience or R&D was identified.

1. ***Quality management:***

Site quality assurance procedures, review and approval processes, and administrative controls are implemented (e.g., 10 CFR 50, Appendix B [6]).

**References**

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