## AMP 132 ABOVE GROUND METALLIC TANKS (VERSION 2021)

### Programme Description

The Aboveground Metallic Tanks AMP manages the effects of loss of material and cracking on the outside and inside surfaces of above ground tanks constructed on concrete or soil, including those tanks that are exposed to an indoor air environment. If the tank exterior is fully visible, the programme for inspection of external surfaces may be used instead (AMP 134). This programme credits the standard industry practice of coating or painting the external of steel tanks as a preventive measure to mitigate corrosion. The programme relies on periodic inspections to monitor degradation of the protective paint or coating. The inside surfaces of tanks are inspected periodically by visual or surface examinations, as appropriate, to detect applicable ageing effects. However, for storage tanks supported on earthen or concrete foundations, corrosion may occur at inaccessible locations, such as the tank bottom. Accordingly, verification of the effectiveness of the programme is performed to ensure that significant degradation in inaccessible locations is not occurring and that the component intended function is maintained during the period of extended operation [1-2]. For reasons set forth below, an acceptable verification programme consists of thickness measurement of the tank bottom surface.

### Evaluation and Technical Basis

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

The programme consists of periodic inspections of metallic tanks (with or without coatings) to manage the effects of corrosion on the intended function of these tanks - integrity. Inspections cover the entire outer surface of the tank. Because lower portions of the tank are on concrete or soil, this programme includes the bottom of the tank as well. If the tank exterior is fully visible, the programme for inspection of external surfaces may be used instead (AMP 134). This programme is used to manage the ageing effects for coatings/linings that are applied to the internal surfaces of tanks as long as AMP 157 is incorporated into this programme.

A risk-based graded approach is applied during scoping, taking into consideration of safety, accessibility and operational constraints associated with draining, entering, and cleaning the tanks, to perform the required inspection and monitoring.

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

In accordance with industry practice, tanks may be coated with protective paint or coating to protect the external surface of the tank from environmental exposure. Where water ingress is possible due to the configuration of the tank foundation, sealant or caulking is applied at the external interface between the tank and concrete or earthen foundation to protect the bottom surface of the tank by minimizing the amount of water and moisture penetrating the interface, which would lead to corrosion of the bottom surface. The applicant provides a justification when sealant or caulking is not applied. In addition, certain tank configurations and designs may minimize the amount of water and moisture penetrating this external interface between the tank and concrete or earthen foundation (e.g., foundation is sloped in a manner that prevents water from accumulating).

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

The programme consists of periodic inspections of metallic tanks (with or without coatings) to manage the effects of corrosion and cracking on the intended function of these tanks. These inspections cover all surfaces of the tank (i.e., outside insulated surfaces, bottom, interior surfaces) to ensure that significant degradation is not occurring and that the component intended function is maintained during the period of extended operation.

Degradation of an exterior metallic surface can occur in the presence of moisture; therefore, visual inspections are performed at each outage to ensure the paint, coating, sealant and caulking is intact and that the surface is protected from moisture. The visual inspections of sealant and caulking are supplemented with physical manipulation to detect degradation. For exterior surfaces that are not coated and for internal surfaces, visual inspections are performed within sufficient proximity (e.g., distance, angle of observation) to detect loss of material. If the tank is insulated, the inspections include locations where potential leakage past the insulation could be accumulating. To detect cracking in susceptible materials such as stainless steel and aluminium, surface examinations are on sampling basis as described in XI.M29 of [2]. The effects of corrosion of the inaccessible external surface are detectable by UT thickness measurement of the tank bottom whenever the tank is drained or on a periodic basis.

If the exterior surface of an outdoor tank or indoor tank exposed to condensation (e.g. being operated below the dew point) is insulated, sufficient insulation is removed to determine the condition of the exterior surface of the tank, unless it is demonstrated that the ageing effect (i.e. SCC, loss of material) is not applicable. During each 10-year period of the subsequent period of extended operation, remove a minimum of either 25 one-square foot sections or 20 percent of the tank insulation and perform inspection of the exposed exterior surface of the tank. Alternative methods to removing insulation to perform tank inspections are described in XI.M29 of [2]. The sample inspection points are based on the likelihood of corrosion under insulation occurring as described in XI.M29 of [2]. When inspections of insulated tanks are conducted on a sampling basis, subsequent inspections are conducted in different locations unless otherwise justified.

Detailed information for inspection techniques, frequency of inspection and inspection sampling is described in XI.M29 of [2]. Other alternative inspection and monitoring methodologies can also be considered in recognition of accessibility and operational constraints.

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

The AMP utilizes periodic plant inspections to monitor degradation of coatings, sealants, and caulking because it is a condition directly related to the potential loss of materials. Additionally, thickness measurements of the bottoms of the tanks are made periodically for the tanks monitored by this programme as an additional measure to ensure that loss of material is not occurring at locations that are inaccessible for inspection. UT thickness measurements of the tanks are monitored and trended if significant material loss is detected where multiple measurements are available.

The effects of corrosion of the tank surfaces are detectable by visual and surface (for cracking) examination techniques. Where practical, identified degradation is trended and these results are evaluated against acceptance criteria to confirm that the components’ intended function is maintained until subsequent inspections are performed based on the rate of degradation.

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

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

1. ***Acceptance criteria:***

Any degradation of paints or coatings (cracking, flaking, or peeling) is reported and requires further evaluation. Drying, cracking, or missing sealant and caulking are unacceptable and need to be evaluated using the corrective action programme. The evaluation will determine the need to repair or replace the sealant and caulking. When degraded sealant or caulking is detected, an evaluation is conducted to determine the need to conduct follow up examination of the tank’s surfaces. Indications of cracking are analysed in accordance with the applicable national regulations, codes, standards, guidelines and design requirements. UT thickness measurements of the tank bottom are evaluated against the design thickness and corrosion allowance.

1. ***Corrective actions:***

Unacceptable inspection findings are evaluated in accordance with the site’s corrective action process to determine appropriate corrective actions and the need for subsequent (including periodic) inspections under another AMP. Additional inspections are conducted if inspections results do not meet acceptance criteria due to current or projected degradation (i.e., trending) unless repairs are performed. The number of additional inspections is determined by the site’s corrective action programme. However, for situations in which inspections where only one tank of a material, environment, and ageing effect was performed and for other sampling-based inspections, further guidance is discussed XI.M29 of [2]. The timing of these additional inspections is based on the severity of the degradation identified and is commensurate with the potential for loss of intended function; however, unique situations may exist that warrant further consideration as discussed in XI.M29 of [2]. Flaws in the caulking or sealant are repaired or replaced.

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.

Coating degradation, such as flaking and peeling, has occurred in safety-related systems and structures [3]. Corrosion damage near the concrete-metal interface and sand-metal interface has been reported in metal containments [4-7]. Stress corrosion cracking, and/or high stress low cycle fatigue has been identified in refuelling water storage tanks at several plants [8].

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

1. ***Quality management:***

Site quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the different national regulatoryrequirements (e.g., 10 CFR 50, Appendix B [9]).

### References

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Final Report of the Programme on Safety Aspects of Long Term Operation of Water Moderated Reactors, IAEA Programmatic Guidelines for Ageing Management No. IAEA-EBP-SALTO, IAEA, Vienna (2007)

[2] UNITED STATES NUCLEAR REGULATORY COMMISSION, Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report — Final Report (NUREG-2191), USNRC, 2017

[3] UNITED STATES NUCLEAR REGULATORY COMMISSION, NRC Generic Letter 98-04, Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System after a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment, July 14, 1998

[4] UNITED STATES NUCLEAR REGULATORY COMMISSION, NRC Information Notice 89-79, Degraded Coatings and Corrosion of Steel Containment Vessel, December 1, 1989

[5] UNITED STATES NUCLEAR REGULATORY COMMISSION, NRC Information Notice 89-79, Supplement 1, Degraded Coatings and Corrosion of Steel Containment Vessel, June 29, 1990

[6] UNITED STATES NUCLEAR REGULATORY COMMISSION, NRC Information Notice 86-99, Degradation of Steel Containments, December 8, 1986

[7] UNITED STATES NUCLEAR REGULATORY COMMISSION, NRC Information Notice 86-99, Supplement 1, Degradation of Steel Containments, February 14, 1991

[8] UNITED STATES NUCLEAR REGULATORY COMMISSION, NRC Information Notice 2013-18, Refuelling Water Storage Tank Degradation September 13, 2013

[9] 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, Latest Edition