## AMP 130 FIRE PROTECTION (VERSION 2020)

### Programme Description

For operating plants, the Fire Protection AMP includes a fire barrier inspection programme. The fire barrier inspection programme requires periodic visual inspections of the entire fire barriers, such as the fire rated walls, floors and ceilings. Furthermore, it requires periodic visual as well as functional in-service inspections of fire barrier elements such as fire doors, hatches and dampers, smoke removal dampers and penetration seals for e.g. cables and ventilations ducts penetrating fire barriers to ensure their required fire protection function. The AMP also includes periodic in-service inspections and testing of the gas-based fire extinguishing systems.

IAEA Safety Guide NS-G-1.7 [1] provides Member States with general recommendations and guidance for protection against internal fires. Further relevant recommendations and guidance are contained in IAEA Safety Guides NS-G-2.1 [2] and NS-G-2.6 [3]. Examples of a national approach are provided in the Japanese codes and guidelines on fire protection [4-6], and the United States of America “Generic Aging Lessons Learned for Subsequent License Renewal” report [7].

### Evaluation and Technical Basis

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

This programme manages ageing effects on the intended function of the fire barriers and their elements, in particular the fire rated walls, floors and ceilings, including penetrations seals, but also protective (typically intumescent or ablative) coatings and wrapping of cables and cable trays or steel beams. The AMP also covers fire rated doors, gateways, hatches as well as fire and smoke dampers. Furthermore, it manages ageing effects on the intended fire protection function of gas-based fire extinguishing systems.

The ageing effects of masonry walls that are considered fire barriers also are managed by AMP 305, as well as being managed by this programme.

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

This is a condition monitoring programme. However, the fire hazard analysis assesses the plant area / compartment specific potential for fires occurring and the fire hazards in all plant areas. It also specifies measures for fire prevention, fire detection, fire suppression, and fire containment and alternative shutdown capability for each fire area containing structures and components important to safety.

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

The detection of ageing effects is mainly based on visual inspections and functional tests. In principle, the inspection intervals are to be defined in a component-specific way, taking into account all relevant stressors as well as the operating experience.

Visual inspections by qualified fire protection inspectors or authorized experts (on behalf of the regulatory authority) of the fire barrier elements, including not only walls, floors and ceilings but also other elements such as doors, gateways, hatches, dampers, etc., are regularly performed in walk-downs at a frequency in accordance with an approved fire protection programme based on national requirements. These inspections (in some countries belonging to the in-service inspection pro­gramme) typically ensure timely detection of concrete cracking, spalling, porosity, loss of material, etc. caused for instance by freeze-thaw, chemical attack, or reaction with aggregates that could affect their intended fire protection function. Furthermore, these inspections detect any sign of degradation of the fire protection elements, such as wear and missing parts.

Periodic visual inspection and functional tests, typically carried out in the frame of in-service inspections, detect any degradation of fire barrier elements, such as fire doors, gateways, hatches, fire and smoke dampers, before there is a loss of the intended fire protection function.

Visual inspection of penetration seals detects cracking, seal separation from walls and components, as well as rupture and puncture of seals. Visual inspections by qualified fire protection inspectors or authorized experts of a representative sample of each type of seal in walk-downs is regularly performed at a frequency in accordance with an approved fire protection programme based on national requirements. If any sign of degradation is detected within that sample, the scope of the inspection is expanded to include additional seals.

Visual inspections of stationary gas-based fire extinguishing systems are performed to detect any sign of corrosion, blockages in the pipework, etc. Typically, periodic in-service inspections, including visual inspection as well as functional tests, are performed on a regular basis on a schedule in accordance with an approved fire protection programme based on the national requirements. Inspections are performed to timely detect degradation of the systems before the loss of the intended fire protection function of the component.

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

This programme is a condition monitoring programme that will detect the ageing effects of concern such that, should ageing effects be identified, remediation of the condition can be accomplished, as necessary. This programme does not mitigate the ageing effects that are within the scope of this programme.

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

The results of inspections of the ageing effects observed at the above mentioned fire barrier elements, in particular of cracking, spalling, and loss of material, are trended to provide for timely detection of ageing effects so that the appropriate corrective actions can be taken. Where practical, identified degradation is projected until the next scheduled inspection. Results are evaluated against acceptance criteria to confirm that the timing of subsequent inspections will maintain the components’ intended functions based on the projected rate of degradation. For sampling-based inspections, results are evaluated against acceptance criteria to confirm that the sampling bases (e.g., selection, size, frequency) will maintain the components’ intended functions based on the projected rate and extent of degradation.

The performance of the stationary gas-based fire extinguishing systems is typically monitored during periodic in-service inspections or tests to detect any degradation in the system (e.g. corrosion, blockages by impurities). These periodic tests provide data necessary for trending.

1. ***Acceptance criteria:***

Inspection results are acceptable if there are no signs of degradation that could result in the loss of the fire protection capability due to loss of material. The acceptance criteria include (a) no visual indications (outside those permitted by approved penetration seal configurations) of cracking, separation of seals from walls and components, separation of layers of material, or ruptures or punctures of seals; (b) no significant indications of concrete cracking, spalling, or loss of material of passive fire barrier elements, such as walls, ceilings, and floors; (c) no visual indications of missing parts, holes, and wear; (d) no visual indications of cracks or corrosion of fire damper assemblies; and (e) no deficiencies in the functional tests of active fire barrier elements, such as doors, etc. Also, inspection results for the gas-based fire extinguishing system are acceptable if there are no indications of excessive loss of material or other degradation.

1. ***Corrective actions:***

For fire protection systems, structures and components identified that are subject to an AMR, an adequate programme is used for corrective actions, confirmation process, and administrative controls for ageing management during the period of extended operation.

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.

Silicone foam fire barrier penetration seals have experienced splits, shrinkage, voids, lack of fill, and other failure modes (U.S. NRC Information Notices (IN) IN 88-56 [8], IN 94-28 [9], and IN 97-70 [10]). Degradation of electrical raceway fire barrier such as small holes, cracking, and unfilled seals are found on routine walk-down (IN 91-47 [11] and NRC Generic Letter 92-08 [12]). Fire barrier elements such as doors and dampers have experienced wear of the hinges and handles, stiffness, and de-adjustments (see also the German experience with respect to fire barrier element reliability [13-15]).

Results from in-service inspections of fire suppression features, such as stationary gas-based fire extinguishing systems have also indicated functional degradations, such as stiffness, deficiencies in leak tightness, insufficient pressure due to impurities, corrosion, etc. (see [13-15]).

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

1. ***Quality management:***

Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with the national requirements (e.g. [16]).

### References

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Protection against Internal Fires and Explosions in the Design of Nuclear Power Plants, Safety Guide No. NS-G-1.7, IAEA, Vienna, 2004.

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Fire Safety in the Operation of Nuclear Power Plants Safety Guide, IAEA Safety Guide No. NS-G-2.1, IAEA, Vienna, 2000.

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants, Safety Guide No. NS-G-2.6, IAEA, Vienna, 2002.

[4] Japan Electric Association, Fire-protection codes for nuclear power plants, JEAC 4626, JEA, 2010.

[5] Japan Electric Association, Fire-protection guidelines for nuclear power plants, JEAG 4607, JEA, 2010.

[6] Japan Electric Association, Fire-protection management guidelines for nuclear power plants, JEAG 4103, JEA, 2009.

[7] UNITED STATES NUCLEAR REGULATORY COMMISSION, “Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report,” NUREG-2191, USNRC, Washington, July 2017.

[8] UNITED STATES NUCLEAR REGULATORY COMMISSION, Information Notice 88-56, Potential Problems with Silicone Foam Fire Barrier Penetration Seals, USNRC, Washington, August 14, 1988.

[9] UNITED STATES NUCLEAR REGULATORY COMMISSION, Information Notice 94-28, Potential Problems with Fire-Barrier Penetration Seals, USNRC, Washington, April 5, 1994.

[10] UNITED STATES NUCLEAR REGULATORY COMMISSION, Information Notice 97-70, Potential Problems with Fire Barrier Penetration Seals, USNRC, Washington, September 19, 1997.

[11] UNITED STATES NUCLEAR REGULATORY COMMISSION, Information Notice 91-47, Failure of Thermo-Lag Fire Barrier Material to Pass Fire Endurance Test, USNRC, Washington, August 6, 1991.

[12] UNITED STATES NUCLEAR REGULATORY COMMISSION, Generic Letter 92-08, Thermo-Lag 330-1 Fire Barrier, USNRC, Washington, December 17, 1992.

[13] Forell, B., S. Einarsson, M. Röwekamp, H.-P. Berg, Updated Technical Reliability Data for Fire Protection Systems and Components at a German Nuclear Power Plant, Paper in: Conference Proceedings of PSAM11 Conference, Helsinki, Finland, 2012.

[14] Forell, B., S. Einarsson, Reliability Data for Fire protection Features in German Nuclear Power Plants, in: Proceedings of SMiRT 21, 12th International Seminar on Fire Safety in Nuclear Power Plants and Installations, September 13-15, 2009, Munich, Germany, 2011.

[15] Türschmann, M., M. Röwekamp, H.-P. Berg, German Plant Specific and Generic Reliability Data for Active Fire Protection Features, International Workshop on Fire PSA – Puerto Vallarta; Mexico, May 23-26th, 2005, 2005.

[16] 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, Washington, Latest Edition.