## AMP 305 MASONRY WALLS (VERSION 2020)

**Programme Description**

This programme provides guidance for developing a plant specific AMP for the masonry walls such that their failure will not have a negative impact on the safe operation of the plant.

United States Nuclear Regulatory Commission (U.S.NRC) Information Notice (IN) 87-67 [1] constitutes an acceptable basis for a masonry wall AMP and recommends plant-specific condition monitoring of masonry walls and administrative controls to ensure that the evaluation basis of masonry walls is not invalidated by: (a) deterioration of the masonry walls (e.g. new cracks not considered in the evaluation basis), (b) physical plant changes such as installation of new safety-related systems or components in close proximity to masonry walls, or (c) reclassification of systems or components from non-safety-related to safety-related, provided appropriate evaluation is performed to account for such occurrences.

Important elements in the evaluation of masonry walls include: (a) installation of steel edge supports to provide a sound technical basis for boundary conditions used in seismic analysis, and (b) installation of steel bracing to ensure stability or containment of unreinforced masonry walls during a seismic event. Consequently, in addition to the development of cracks in the masonry walls, loss of function of the structural steel supports and bracing would invalidate the evaluation basis. The steel edge supports and steel bracings are considered component supports and their ageing effects are managed by AMP 306.

The programme requires periodic visual inspection of masonry walls in the scope of ageing management, to detect loss of material and cracking of masonry units and mortar. The ageing effects that could impact masonry wall intended function or potentially invalidate its evaluation basis are entered in the corrective action process for further analysis, repair, or replacement.

The personnel performing the visual inspections of the masonry walls work under the direction of the responsible structural engineer and are qualified structural engineers who have over one year of experience in the inspection and evaluation of in-service structures. The responsible structural engineer is qualified, knowledgeable in the design, evaluation, and in-service inspection of concrete structures and performance requirements of nuclear safety-related structures. All personnel involved with inspection and evaluation of masonry walls also meet the qualification requirements of the appropriate member state regulatory authority.

The ageing effects on masonry walls that are considered fire barriers also are managed by the AMP 130.

**Evaluation and Technical Basis**

1. ***Scope of the Ageing Management Programme based on understanding ageing:***

The scope of the programme is based on the member states nuclear regulatory authority for ageing management of nuclear power plant systems, structures, and components. In absence of specific guidance from the member state regulatory authority, it could be based on guidance provided in IAEA Specific Safety Guide SSG-48 [2] and U.S.NRC Code of Federal Regulations 10 CFR 54 [3] and include the following walls:

1. Safety related masonry walls that are required to remain functional during and following design basis events to ensure that the integrity of the reactor coolant pressure boundary; or the capability to shut down the reactor and maintain it in a safe shutdown condition; or the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures beyond the design basis of the plant;
2. All non-safety related masonry walls whose failure could prevent satisfactory performance of safety related structures and components;
3. All masonry walls relied on in safety analyses or plant evaluations to perform a function for fire protection, environmental qualification, pressurized thermal shock, anticipated transients without scram, and station blackout.

The ageing effects of masonry walls that are considered fire barriers also are managed by AMP 130, as well as being managed by this programme.

1. ***Preventive Actions to Minimize and Control Ageing Degradation:***

This is a condition monitoring programme and no specific preventive actions are required.

1. ***Detection of Ageing Effects:***

The primary parameters monitored are potential shrinkage and/or separation and cracking of masonry walls, cracking and loss of material of mortar joints and gaps between the supports and masonry walls that could impact the intended function or potentially invalidate its evaluation basis. Masonry wall cells may or may not contain reinforcing steel. If contain, the potential for corrosion of embedded steel and steel reinforcement (rebar) in masonry walls are the same as those that affect reinforced concrete walls as described in AMP 306. If masonry walls are reinforced with polymer, the loss of mechanical properties of the polymer due to elevated temperature, oxygen, ozone and ionizing irradiation should be considered.

Visual examination of the masonry walls by qualified inspection personnel is sufficient. In general, masonry walls are inspected every five years, with provisions for more frequent inspections in areas where significant loss of material or cracking is observed to ensure there is no loss of intended function or if trending predictions indicate that the acceptance criteria will not be met if the original schedule is maintained.

However, masonry walls that are fire barriers are visually inspected in accordance with AMP 130.

1. ***Monitoring and Trending of Ageing Effects:***

Trending provides a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions. Trending of inspection is based on established recommended inspection techniques. If trending predictions indicate that the acceptance criteria will not be met, the frequency of inspections is changed. Condition monitoring for evidence of shrinkage and/or separation and cracking is achieved by periodic examination. Degradation detected from monitoring is evaluated.

1. ***Mitigating Ageing Effects:***

This AMP is a condition monitoring programme and no generic recommendations are included to mitigate ageing effects.

1. ***Acceptance Criteria:***

For each masonry wall, the extent of observed shrinkage and/or separation and cracking of masonry walls, loss of material and cracking of mortar joints and gaps between the supports and masonry walls may not invalidate the evaluation basis or impact the wall’s intended function. However, further evaluation is conducted to provide adequate technical justification if the extent of cracking and loss of material is sufficient to impact the intended function of the wall or invalidate its evaluation basis.

1. ***Corrective Actions:***

In the case of significant degradation of masonry wall is identified, the cause of condition is determined, and corrective actions taken to preclude repetition are documented. Potential corrective action option is to develop a new analysis or evaluation basis that accounts for the degraded condition of the wall (i.e., acceptance by further evaluation). Other alternatives include repair (re-plastering, pointing, etc.) or replacing the degraded masonry wall.

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.

Appropriate source of external operating experience is Ageing Management of Concrete Structures in Nuclear Power Plants IAEA Nuclear Energy Series No. NP-T-3.5, 2016 [4].

Since 1980, masonry walls that perform an intended function have been systematically identified through plant programmes. In many countries, the use of unreinforced masonry walls for safety related structures is prohibited. NRC IN 87-67 [1] documented lessons learned from the NRC IEB 80-11 [5] programme and provided recommendations for administrative controls and periodic inspection to ensure that the evaluation basis for each safety-significant masonry wall is maintained. NUREG-1522 [6] documents instances of observed cracks and other deterioration of masonry-wall joints at nuclear power plants. EPRI Structural Tools [7] reviews the ageing effects and mechanisms applicable to masonry walls. Whether conducted as a stand-alone programme or as a part of structures monitoring, an AMP for masonry walls that incorporates the recommendations delineated in NRC IN 87-67 [1] ensures that the intended functions of all masonry walls, within the scope of ageing management, are maintained for the period of intended period of operation.

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

1. ***Quality Management:***

Administrative controls, quality assurance procedures, review and approval processes, are implemented in accordance with the different national regulatory requirements (e.g., 10 CFR 50, Appendix B [8]).

### References

1. UNITED STATES NUCLEAR REGULATORY COMMISSION, Information Notice 87-67, Lessons Learned from Regional Inspections of Licensee Actions in Response to IE Bulletin 80-11, USNRC, 1987.
2. INTERNATIONAL ATOMIC ENERGY AGENCY, Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants, IAEA Safety Standards Series No. SSG-48, IAEA, Vienna 2018.
3. UNITED STATES NUCLEAR REGULATORY COMMISSION, 10 CFR 54, License Renewal Rule, Office of the Federal Register, National Archives and Records Administration, USNRC, Latest Edition.
4. INTERNATIONAL ATOMIC ENERGY AGENCY, Ageing Management of Concrete Structures in Nuclear Power Plants, IAEA Nuclear Energy Series No. NP-T-3.5, 2016.
5. UNITED STATES NUCLEAR REGULATORY COMMISSION, IE Bulletin 80-11, Masonry Wall Design, USNRC, 1980.
6. UNITED STATES NUCLEAR REGULATORY COMMISSION, NUREG-1522, Assessment of In-service Condition of Safety-Related Nuclear Power Plant Structures,USNRC, 1995.
7. ELECTRIC POWER RESEARCH INSTITUTE, Aging Effects for Structures and Structural Components for Subsequent License Renewal (Structural Tools for SLR). EPRI, Palo Alto, CA: 2018. 3002013084.
8. 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, Latest Edition.