### AMP 303 safety CLASS 1, 2 AND 3 PIPING AND METAL CONTAINMENT cOMPONENTS supports (VERSION 2018)

### Programme Description

This document provides guidance for developing a plant specific ageing management programme for the nuclear power plant safety class 1, 2 and 3 piping and metal containment (MC) supports. IAEA/Global Safety Assessment Network (GSAN) document, "Safety Classification” [1] provides definition of the different safety classes. For light water-cooled plants, class 1, 2, 3 piping and MC supports are designated as ASME Class 1, 2, 3 piping and MC supports.

The primary ISI method specified in this AMP is visual examination of a sample of the total Class 1, 2, and 3 piping support populations. The sample size varies depending on the safety class of the supports. The largest sample size is specified for the most critical safety class 1 supports. The sample size decreases for the less critical safety class 2 and 3 supports. This approach is consistent with the recommendations in the different member states national codes and standards [2-4] as well as with the regulatory in-service inspection guidance documents [5-17]. For MC supports, some member states (MS) inspect all of MC supports [2] while some MS inspect a sample of the MC supports [3]. This AMP is not applicable to piping and component supports in CANDU/PHWR nuclear power plants. The ageing management for piping and component supports in CANDU/PHWR nuclear power plants is provided in AMP 146.

Discovery of support deficiencies during regularly scheduled inspections triggers an increase of the inspection scope in order to ensure that the full extent of deficiencies is identified. Degradation that potentially compromises support function or load capacity is identified for evaluation. The programme includes acceptance criteria and corrective actions. Supports requiring corrective actions are re-examined during the next inspection period.

The programme includes preventive actions for degradation and failure of structural bolts. Guidance provided in applicable industry standards and guidance documents, including United States Nuclear Regulatory Commission’s (USNRC) document NUREG-1339 [18] and Electric Power Research Institute (EPRI) documents NP-5769 [19], NP-5067 [20], and TR-104213 [21] can be used to ensure structural bolting integrity. These recommendations emphasize proper selection of bolting material, lubricants, and installation torque or tension to prevent or minimize loss of bolting preload and cracking of high-strength bolting.

Personnel performing the inspections of the safety class 1, 2, and 3 piping and MC supports are qualified and certified in accordance with the different member states codes and standards [22-23].

This programme includes a one-time inspection of additional supports prior to the period of extended operation for each group of materials used and the environments to which they are exposed. Additional supports are outside of the existing inspection sample population (e.g. ASME Subsection IWF [2]).

### Evaluation and Technical Basis

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

This programme addresses supports for safety class 1, 2, 3 piping and MC supports. Portions of supports that are inaccessible by being encased in concrete, buried underground, or encapsulated by guard pipe are exempt from examination. Different member states codes and standards and/or plant licensing documents may identify additional supports as being exempt from inspection. In absence of, or to supplement any specific guidance in plant licensing documents, IWF-1230 of [2] can be used to identify exempted supports. The scope of the programme includes support members, structural bolting, high-strength structural bolting, welding, anchor bolts, support anchorage to the building structure, accessible sliding surfaces, constant and variable load spring hangers, guides, stops, and vibration isolation elements.

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

This programme is a condition monitoring programme and has no preventive actions. However, the programme is augmented to require that the selection of bolting materials, installation torque or tension and the use of lubricants and sealants are to prevent or mitigate degradation and failure of structural bolting [19-20]. Preventive actions for structural bolting storage, lubricants, and stress corrosion cracking potential are to be taken into account [24- 25].

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

The examination methods, frequency, and scope of examination specified ensure that ageing effects are detected before they compromise the design-basis requirements.

The programme requires that a sample of safety Class 1, 2, and 3 piping supports that are not exempt from examination is selected for inspection/examination. The Sample size may be determined based on the member states regulations or codes and standards. In absence of any specific guidance in the member states regulations or codes and standards or plant licensing documents, Table IWF-2500-1 of [2] or Table IF-2500-1 of [3] is used to determine the sample size, extent, frequency, and examination methods. ASME Section XI requires 100 % inspection for MC component supports. The extent, frequency, and examination methods are designed to detect, evaluate, or repair age-related degradation before there is a loss of component support intended function.

This programme includes a one-time inspection of additional supports prior to the period of extended operation for each group of materials used and the environments to which they are exposed. Additional supports are outside of the existing inspection sample population (e.g. ASME Subsection IWF [2]).

The parameters monitored or inspected include corrosion; deformation; misalignment of supports; missing, detached, or loosened support items; improper clearances of guides and stops; and improper hot or cold settings of spring supports and constant load supports. Accessible areas of sliding surfaces are monitored for debris, dirt, or indications of excessive loss of material due to wear that could prevent or restrict sliding as intended in the design basis of the support. Elastomeric vibration isolation elements are monitored for cracking, loss of material, and hardening. Structural bolts are monitored for corrosion and loss of integrity of bolted connections due to self-loosening and material conditions that can affect structural integrity. High-strength structural bolting (actual measured yield strength greater than or equal to 150 Ksi or 1,034 MPa) susceptible to stress corrosion cracking (SCC) is monitored for SCC.

Examinations are implemented consistent with pertinent governing requirements or guidance documents for the plant. Detection of ageing effects should occur before there is a loss of the structure and structural component intended function(s). The parameters to be monitored or inspected are appropriate to ensure that the structure and component intended function(s) will be adequately maintained for the period of operation under all design conditions.

Standards for examination methods, procedures and personnel are provided in the programme, with preference to well-established examination methods. These methods include volumetric (UT) examination methods for detecting flaws in bolting, physical measurements for detecting changes in dimension, and different visual (VT-3, VT-1) examinations for detection of general surface conditions and detection and sizing of surface-breaking discontinuities.

A description of the visual examinations is:

* Visual VT-1 examination detects discontinuities and imperfections, such as cracks, corrosion, wear, or erosion, on the surface of components;
* Visual VT-3 examination (a) determines the general mechanical and structural condition of components and their supports by verifying parameters such as clearances, settings, and physical displacements; (b) detects discontinuities and imperfections, such as loss of integrity at bolted or welded connections, lose or missing parts, debris, corrosion, wear, or erosion; and (c) observes conditions that could affect operability or functional adequacy of constant-load and spring-type components and supports.

Visual examinations are performed, either directly or remotely, by line of sight from available viewing angles from ﬂoors, platforms, walkways, ladders, or other permanent vantage points, unless temporary access is required by the inspection plan. The visual examinations are performed with adequate illumination, sufficient to detect evidence of degradation.

Flaws or degradations identified during the performance of a VT–3 examination are examined in accordance with the VT–1 examination method. The criteria in the material specification or governing requirements or guidance documents are used to evaluate bolting flaws or degradation. As an alternative to performing VT–3 examinations of the bolted connections that can be disassembled, VT–3 examinations of containment bolted connections may be conducted whenever containment bolted connections are disassembled for any reason.

The VT-3 visual examination is conducted for the safety class 1, 2, and 3 piping and MC supports to reveal loss of material due to corrosion and wear, verification of clearances, settings, physical displacements, lose or missing parts, debris or dirt in accessible areas of the sliding surfaces, or loss of integrity at bolted connections. The VT-3 visual examination is also used to detect loss of material and cracking of elastomeric vibration isolation elements. The VT-3 visual examination of elastomeric vibration isolation elements are supplemented by feel to detect hardening if the vibration isolation function is suspect. If the VT-3 visual examinations detect surface flaws which exceed acceptance criteria, supplementary surface VT-1 or volumetric UT examinations to determine the character of the flaw are required.

For high-strength structural bolting in sizes greater than 1 inch nominal diameter (including ASTM A325, ASTM F1852 and ASTM A490 bolts), volumetric UT examination comparable to that of Examination Category B-G-1 in Table IWB-2500-1of [26], are performed to detect cracking in addition to the VT-3 examination. This volumetric UT examination may be waived with adequate plant-specific justification. Other structural bolting (ASTM A325, ASTM F1852, and ASTM A490 bolts) and anchor bolts are monitored for loss of material, lose or missing nuts, and cracking of concrete around the anchor bolts. An example of checks for anchor bolts and signs of impaired conditions to look for (caveats) is given in [27]. These include condition of the anchor bolt, nut, baseplate, underlying grout (if present), required bolt torque, concrete condition in the vicinity.

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

The safety class 1, 2, 3 piping and MC component supports are examined periodically, as required by the different member states codes and standards, and regulations. In absence or to supplement the specific requirements in the plant licensing documents, inspection schedule prescribed in Table IWF-2400-2 of [2] are used. Sequence of component support examinations established during the first inspection interval is repeated during each successive inspection interval, to the extent practical.

Component supports whose examinations do not reveal unacceptable degradations are accepted for continued service. Verified changes of conditions from prior examination are recorded. Component supports whose examinations reveal unacceptable conditions and are accepted for continued service by corrective measures or repair/ replacement activity are reexamined during the next inspection period. When the reexamined component support no longer requires additional corrective measures during the next inspection period, the inspection schedule may revert to its regularly scheduled inspection. Examinations that reveal indications which exceed the acceptance standards and require corrective measures are extended to include the component supports immediately adjacent to those component supports for which corrective action is required. IWF-2430 of [2] provides guidance for extending the inspection scope to include additional supports if the inspection of adjacent supports also reveals unacceptable conditions. If a component support does not exceed the acceptance standards but is repaired to as-new condition, the sample is increased or modified to include another support that is representative of the remaining population of supports that were not repaired.

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

AMP 303 is a condition monitoring programme and no mitigating ageing effects are intended.

1. ***Acceptance criteria:***

The programme provides specific examination acceptance criteria for the inspection of the safety class 1, 2, 3 piping and MC component supports. As a minimum, for visual examination the following conditions, as specified in IWF-3400 of [2] are unacceptable:

(a) Deformations or structural degradations of fasteners, springs, clamps, or other support items;

(b) Missing, detached, or loosened support items, including bolts and nuts;

(c) Arc strikes, weld spatter, paint, scoring, roughness, or general corrosion on close tolerance machined or sliding surfaces;

(d) Improper hot or cold positions of spring supports and constant load supports;

(e) Misalignment of supports;

(f) Improper clearances of guides and stops.

Other unacceptable conditions include:

(a) Loss of material due to corrosion or wear;

(b) Debris, dirt, or excessive wear that could prevent or restrict sliding of the sliding surfaces as intended in the design basis of the support;

(c) Cracked or sheared bolts, including high-strength bolts, and anchors;

(d) Loss of material, cracking, and hardening of elastomeric vibration isolation elements that could reduce the vibration isolation function.

The above conditions may be accepted provided the technical basis for their acceptance is documented.

1. ***Corrective actions:***

Evaluations are performed for any inspection results that do not satisfy established criteria. Corrective actions are initiated in accordance with the corrective action process if the evaluation results indicate there is a need for a repair or replacement. In addition, the corrective actions include assessment for mitigating the root cause of the degradation. In absence of any plant specific requirements for corrective actions, the requirements in [28] can be used to address the corrective actions.

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.

Appropriate source (s) of external operating experience is/are Ageing Management of Concrete Structures in Nuclear Power Plants (IAEA Nuclear Energy Series No. NP-T-3.5 (2016) [29].

To date, IWF sampling inspections as per [2] have been effective in managing ageing effects for safety class 1, 2, 3, and MC supports. There is reasonable assurance that the Subsection IWF inspection programme will be effective in managing the ageing of the in-scope component supports through the period of extended operation.

Degradation of threaded bolting and fasteners has occurred, for example, from boric acid corrosion, SCC, and fatigue loading [30-31]. SCC has occurred in high-strength bolts used for NSSS component supports [19].

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

1. ***Quality Management:***

Site quality assurance procedures, review and approval processes, and administrative controls are implemented in accordance with the different national regulatory requirements (e.g., 10 CFR 50, Appendix B [28].

### References

1. INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Classification of Structures, Systems and Components in Nuclear Power Plants, IAEA Safety Standards Series No. SSG-30, Vienna, 2014.
2. AMERICAN SOCIETY of MECHANICAL ENGINEERS, ASME Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Subsection IWF, Requirements for Class 1, 2, 3, and MC Component Supports of Light-Water Cooled Power Plants, The ASME Boiler and Pressure Vessel Code, ASME, New York, NY, 2007 edition and 2008 addenda as approved in 10 CFR 50.55a Edition, 2015.
3. JSME S NA1, Code for Nuclear Power Generation Facilities - Rule on Fitness-for-Service for Nuclear Power Plants, The Japan Society of Mechanical Engineers, 2015.
4. KERNTECHNISCHER AUSSCHUSS, Safety Standards of the Nuclear Safety Standards Commission (KTA), Components of the Reactor Coolant Pressure Boundary of Light Water Reactor Part: In-service Inspections and Operation Monitoring, KTA 3201.4, KTA, 2010.
5. UNITED STATES NUCLEAR REGULATORY COMMISSION, 10 CFR Part 50.55a, Codes and Standards, Office of the Federal Register, National Archives and Records Administration, USNRC, Latest Edition.
6. UNITED STATES NUCLEAR REGULATORY COMMISSION, Generic Aging Lessons Learned (GALL) Report, NUREG 1801, Rev. 2, USNRC, 2010.
7. KERNTECHNISCHER AUSSCHUSS, Safety Standards of the Nuclear Safety Standards Commission (KTA), Ageing-Management in Nuclear Power Plants, KTA 1403, KTA, 2010.
8. Government Office of Nuclear Safety: Ageing Management of Nuclear Power Equipment, Safety guide JB-2.1, Czech Republic, January 2010 (in Czech language).
9. Normative Technical Documentation of Association of Mechanical Engineers (N.T.D. ASI) Section IV. Residual Lifetime Assessment of Nuclear Power Plant Equipment and Pipelines type VVER (in Czech language, 2013.
10. Technical Standard of Czech Energetical Companies (ČEZ, a.s.) Lifetime management of Power Plants Equipment in ČEZ, ČEZ\_ST\_0006, April 2012 (in Czech language).
11. Guide of Czech Energetical Companies (ČEZ, a.s.) Assets evidence, efficiency, condition and lifetime assessment. ČEZ\_PP\_0330. September 2012 (in Czech language).
12. HUNGARIAN ATOMIC ENERGY AUTHORITY, Guidelines 4.12 On ageing management during operation (Version 3) (in Hungarian), HAEA, 2016.
13. HUNGARIAN ATOMIC ENERGY AUTHORITY Guidelines A4.21 Programme for the Maintenance, Testing and Surveillance in Nuclear Power Plants Version 1 (in Hungarian), HAEA, 2016.
14. NUCLEAR REGULATORY AUTHORITY OF THE SLOVAK REPUBLIC, Ageing management of Nuclear power plants – requirements, BNS I.9.2/2014, UJD SR, Bratislava, 2014.
15. NUCLEAR REGULATORY AUTHORITY OF THE SLOVAK REPUBLIC, Corrosion monitoring of safety significant components of nuclear facilities, BNS II.3.4/2006, UJD SR, Bratislava, 2007.
16. NUCLEAR REGULATORY AUTHORITY OF THE SLOVAK REPUBLIC, Evaluation of acceptability of faults detected during the operation inspection of nuclear installation selected equipment, BNS II.3.1/2007, UJD SR.
17. NUCLEAR REGULATORY AUTHORITY OF THE SLOVAK REPUBLIC, Regulation No. 33/2012 Coll., on the regular, comprehensive and systematic evaluation of the nuclear safety of nuclear equipment, UJD SR, 2016.
18. UNITED STATES NUCLEAR REGULATORY COMMISSION, Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants, NUREG-1339, USNRC, June 1990.
19. ELECTRIC POWER RESEARCH INSTITUTE, Degradation and Failure of Bolting in Nuclear Power Plants, NP-5769, EPRI, Palo Alto, CA, 1988.
20. ELECTRIC POWER RESEARCH INSTITUTE, Good Bolting Practices, A Reference Manual for Nuclear Power Plant Maintenance Personnel, Volume 1: Large Bolt Manual; Volume 2: Small Bolts and Threaded Fasteners, NP-5067, EPRI, Palo Alto, CA,1990.
21. ELECTRIC POWER RESEARCH INSTITUTE, Bolted Joint Maintenance & Application Guide, TR-104213, EPRI, Palo Alto, CA, 1995.
22. AMERICAN SOCIETY of MECHANICAL ENGINEERS, Section XI, Rules for In-service Inspection of Nuclear Power Plant Components, Subsection IWA, General Requirements, The ASME Boiler and Pressure Vessel Code, ASME, New York, NY, 2008.
23. EUROPEAN STANDARD, Non-destructive testing – Qualification and certification of NDT personal – General principles, EN 473, EN 2008.
24. RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS, Specification for Structural Joints Using ASTM A325 or A490 Bolts, RCSC, 2009.
25. RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS, Educational Bulletin No. 3 Recommendations for Purchasing, receiving and storing A325 or A490 Bolts, RCSC, 2009.
26. AMERICAN SOCIETY of MECHANICAL ENGINEERS, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Subsection IWB, Requirements for Class 1 Components of Light-Water Cooled Plants, The ASME Boiler and Pressure Vessel Code, ASME, New York, NY 2010.
27. Seismic Quality Utility Group, Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment, SQUG GIP-3A, USA, 2001.
28. UNITED STATES NUCLEAR REGULATORY COMMISSION, 10 CFR Part 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, National Archives and Records Administration, USNRC, Latest Edition.
29. INTERNATIONAL ATOMIC ENERGY AGENCY, Ageing Management of Concrete Structures in Nuclear Power Plants, IAEA Nuclear Energy Series No. NP-T-3.5, 2016.
30. UNITED STATES NUCLEAR REGULATORY COMMISSION, Generic Safety Issue 79, Bolting Degradation or Failure in Nuclear Power Plants, Generic Letter 91-17, USNRC, 1991.
31. UNITED STATES NUCLEAR REGULATORY COMMISSION, IE Bulletin No. 82-02, Degradation of Threaded Fasteners in the Reactor Coolant Pressure Boundary of Power Plants, USNRC, 1982.