## AMP 123 BWR Control Rod Drive Return Line Nozzle (VERSION 2021)

### Programme Description

This programme is a condition monitoring programme for BWR control rod drive return line (CRDRL) nozzles for addressing thermal fatigue [1]. CRDRL nozzles that have been capped do not need to manage cracking due to thermal fatigue. Stress corrosion cracking (SCC) of the CRDRL piping, nozzles, nozzle caps, and associated welds [2] is managed by AMP 107. The augmented inspections proposed for monitoring the nozzles condition supplement those in service inspections (ISI) that are required for these nozzles in accordance with the applicable standards for the plant. Thus, this programme includes (a) mandatory ISI in accordance with national regulation, and (b) augmented ISI examinations in accordance with applicant’s commitments for thermal fatigue issues.

### Evaluation and Technical Basis

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

This programme manages the effects of cracking due to thermal fatigue on the intended pressure boundary function of CRDRL nozzles and reactor pressure vessel (RPV). The scope of this programme is applicable to BWRs whose RPV design includes a welded CRDRL nozzle design. The scope of the programme includes CRDRL nozzles and their nozzle-to-RPV welds, which are Class 1 components.

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

Activities for preventing or mitigating cracking in CRDRL nozzles are consistent with a BWR facility’s past preventive or mitigation actions/activities. In the United States, plants have implemented modifications [1] to minimize or eliminate cracking due to thermal fatigue.

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

The extent and schedule of inspection, as delineated in the programme, assures detection of cracks before the loss of intended function of the CRDRL nozzles and RPV. Inspection and test recommendations include liquid penetrant test (PT) examinations of CRDRL nozzle bend radius and bore regions, PT Examinations of the RPV wall area beneath the nozzle, and control rod drive system performance testing. The inspection is to include base metal to a distance of one-pipe-wall thickness or 13mm, whichever is greater, on both sides of the weld. For PT examinations that are implemented in accordance with this AMP, the AMP monitors for linear indications that may be indicative of surface breaking cracks. For the volumetric ultrasonic test (UT) examinations that are performed in accordance with this AMP, the AMP monitors and evaluates signals that may indicate the presence of a planar flaw (crack).

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

The inspection schedule provides timely detection of cracks. Indications of cracking are evaluated and trended in accordance with the national standards.

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

See Attribute 2 for guidance.

1. ***Acceptance Criteria:***

Any indication or relevant conditions of degradation may be evaluated for acceptance in accordance with the pertinent governing requirements or guidance documents. Examination results and flaws that exceed the acceptance criteria in the pertinent governing requirements or guidance documents may be evaluated in accordance with the pertinent governing requirements or guidance documents [3-4].

1. ***Corrective actions:***

Corrective action is performed in conformance with national standards or pertinent guidance applicable to the plant.

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.

Cracking of CRDRL nozzle-to-vessel welds has occurred in several BWR plants [1-2]. The present AMP has been implemented for nearly 30 years in some countries.

BWRVIP-74-A [6] provides inspection and evaluation guidelines for CRDRL nozzles that have been approved by the U.S. Nuclear Regulatory Commission and implemented by BWRs in the U.S. and other countries.

At the time when this AMP was produced, no relevant specific 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 [5]).

### References:

1. UNITED STATES NUCLEAR REGULATORY COMMISSION, NUREG-0619, Revision 1, BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking, USNRC, November 1980.
2. UNITED STATES NUCLEAR REGULATORY COMMISSION, NRC Information Notice 2004-08, Reactor Coolant Pressure Boundary Leakage Attributable To Propagation of Cracking In Reactor Vessel Nozzle Welds, USNRC, April 22, 2004.
3. JAPAN SOCIETY OF MECHANICAL ENGINEERS, IA, IB Code for Nuclear Power Generation Facilities - Rule on Fitness-for-Service for Nuclear Power Plants, JSME S NA1 -2008, JSME.
4. ASME, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, The ASME Boiler and Pressure Vessel Code, 2004 edition as approved in 10 CFR 50.55A, The American Society of Mechanical Engineers, New York, NY.
5. 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.
6. BWRVIP-74-A: BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal, EPRI, Palo Alto, CA: 2003. 1008872.