EU TOPICAL PEER REVIEW
AGEING MANAGEMENT ASSESSMENT OF NPP

UPDATED
NATIONAL ACTION PLAN OF
THE REPUBLIC OF BULGARIA

Nuclear Regulatory Agency

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CONTENTS

1. INTRODUCTION

In 2014, the European Union (EU) Council adopted Directive 2014/87/EURATOM amending the 2009/71 Nuclear Safety Directive to incorporate lessons learned following the accident at the Fukushima Daiichi nuclear power plant in 2011. Recognizing the importance of peer review in delivering continuous improvement to nuclear safety, the revised Nuclear Safety Directive introduced an European system of Topical Peer Review (TPR) commenced in 2017 and that has to be done every six years thereafter. The purpose is to provide a mechanism for EU member states to examine topics of strategic importance to nuclear safety, to exchange experience and to identify opportunities to strengthen the nuclear safety.

The 30th Meeting of the European Nuclear Safety Regulators Group (ENSREG), which took place in July 2015 identified the ageing management of nuclear power plants as the topic for the first Topical Peer Review. This selection was supported by a technical assessment performed by the Western European Nuclear Regulators Association (WENRA) taking into account the age profile of the European nuclear reactor fleet and the safety significance of the topic. The Terms of Reference and the Technical Specification of the first Topical Peer Review, as well as the Stakeholder Engagement Plan, were approved by ENSREG in January 2017.

According to the Terms of Reference and the Technical Specification, the peer review focused on the Ageing Management Programmes (AMPs) at Nuclear Power Plants (NPPs) and Research Reactors (RRs) above 1 MWt. Several countries reported on specific aspects of ageing management related to long-term operation (LTO) of NPPs although LTO was not specifically required by technical specifications. In addition to reviewing the programmatic part of ageing management, the peer review process examined the application of the AMPs to the selected systems, structures and components (SSCs) in four thematic areas, namely: electrical cables, concealed piping, reactor pressure vessels, or equivalent structures, and concrete containment structures.

The Republic of Bulgaria operates the Kozloduy Nuclear Power Plant with two WWER-1000 reactors, model B-320, operating in an airtight protective reinforced concrete structure (containment). The units were commissioned in 1987 and 1991, respectively, and their design lives expired in 2017, for Unit 5, and 2021, for Unit 6. Following the completion of review and analyses as well as the implementation of actions included in the plant life extension programme, in November 2017 and October 2019, respectively, the operating licences of the Units 5 and 6 were renewed for a 10-year period.

The objective of the first Topical Peer Review was to examine how well Ageing Management Programmes in the participating countries meet international requirements on ageing management, in particular WENRA Safety Reference Levels and the IAEA Safety Standards. Moreover, the participating countries were enabled to review their provisions for ageing management, to identify good practices and to identify areas for improvement as well to share experience and identify faced common issues.

The TPR provided an open and transparent framework for participating countries to develop follow-up measures to address areas for improvement.

The Topical Peer Review assessed the national reports and the good practices and areas for improvement identified therein. In a Topical Peer Review Report and Country specific findings allocated per participating countries published by the ENSREG findings were allocated as Expected level of performance; Area for improvement and Good practice.

Within the framework of its obligations, the Republic of Bulgaria duly examined all the general findings and the respective country-specific findings.

This Updated Ageing Management National Action Plan (UNAP) was developed in the context of fulfilling the obligations of the Republic of Bulgaria as a member of the European Union in connection with the assumed responsibilities as a state operating a nuclear power plant and provides information on the country’s progress on the actions (measures) implementation by the end of May 2021.

2. STATUS ON IMPLEMENTATION OF THE UPDATED NATIONAL ACTION PLAN

The current revision of the NAP (revision May 2021) comprises totally 8 measures, of which:

- Completed – 5 measures (62 %);
- Under implementation/not started – 3 measures (38 %).

The status of the measures is as follows:

Measure No 1: Optimise the scope of the NRA inspection programme in terms of the type of SSCs and periodicity of their inspections

A new inspection area "Ageing Management" has been added to the scope of the long-term inspection programme, which includes control of ageing management programmes, control of SSCs, important for safety (thermomechanical equipment, electrical equipment, control systems and management and building structures). The sub-areas includes determination of the scope of SSCs, object of aging management, control of ageing management activities, analysis and assessment of the current state of SSCs, corrective measures in case of non-conformities, reporting documents, assessment of the effectiveness of individual component-oriented programs and the ageing management process.

The aging management process is also controlled during the assessment of the inspection areas and sub-areas maintenance, surveillance, operations, control of the water chemistry, equipment qualification, non-destructive testing.

The required resources have been defined on the basis of frequency, durability of inspections and number of involved inspectors.

Measure No 2: Review and update of the list of structures and components within the range of the ageing management system in compliance with the requirements resulting from the latest issued IAEA guidelines on Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants, Specific Safety Guides, SSG-48

Kozloduy NPP has developed and implements a "Methodology for scoping of structures, systems, and components for ageing management" that is in conformity with the requirements of the national regulatory framework and the applicable IAEA guides. The Methodology was reworked in compliance with the requirements of the IAEA safety guide - Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants, Specific Safety Guides No. SSG-48, IAEA, Vienna, 2018.

The scoping of the SSCs covered by the ageing management system is in conformity with the criteria set in SSG-48. The scope of SSCs subject to aging management has been expanded, and in addition to SSCs, performing fundamental safety functions (safety systems) and primary circuit equipment were included all SSCs, important for safety – safety systems and systems of normal operation, important to safety, as well as all SSCs intended for intermediate (temporary) safe storage and handling of spent nuclear fuel (spent fuel pools and connected systems).

In accordance with the extended scope of the Methodology the list of SSCs covered by the ageing management system was reviewed and updated.

Measure No 3: The 0.4kV low voltage cables from the systems important to safety (low voltage cables located in MILD environment) shall be assessed to determine their residual lifetime

The low voltage 0.4 kV cables located in MILD environment are actually operated under normal environmental conditions, which do not change either under normal operation or in case of design basis accidents. Until now, these cables have not been inspected to determine their residual life. These are cables of systems important to safety and those related to the reliability of electricity generation. The tested cables are part of equipment, necessary to mitigate the consequences of an accident, but are not exposed to the effects of the emergency environment and remain available after an accident.

Quantitative (expert) assessment of the residual life of low voltage cables of Units 5 and 6 has been performed. Samples of the cables operated at the plant since 1987, samples replaced during modernization, as well as new samples were analyzed. The methods for monitoring the condition are systematized, the operation of the cables and the possibilities for extending their life are analyzed with a focus on a control and low voltage power cables.

The activities are in progress. The implementation term is to the end of 2021.

Measure No 4: Requalification of 0.4 kV low voltage cables subject to LOCA and HELB qualification, using, when possible, estimations to reduce uncertainties

The activities for implementation of the measure have not started yet. The current qualification of low voltage 0.4 kV cables has been confirmed until 2029. The implementation term is to the end of 2027.

Measure No 5: The cables necessary to mitigate the effects of accidents are qualified to determine their ability to perform their functions under the conditions of extended Beyond Design Basis Accident (BDBA) Conditions and throughout their expected life cycle

The activities have not started yet. The implementation term is to the end of 2028.

Measure No 6: Reconstruction of the penetration of pipelines Nos. 5 and 8 from the QF essential service water supply system

The following activities were performed as a result of the conducted analyses and assessments for ensuring the operability, lifetime characteristics and reliability of the main underground pipelines of the Component Cooling Water System (CCWS) – QF:

- reconstruction of pressure pipeline No 5 in the wall of manhole III 657 and providing radial gap on both sides of the pipe of 20 mm;
- reconstruction of the penetration of pressure pipeline No 8 in the wall of the dosimetric control manhole of system III at unit 6 and providing radial gap on both sides of the pipe of 20 mm.

Measure No 7: Excavation and additional assessment of the section of concealed pipework with anomalies identified by the contactless magnetometric diagnostics; Assessment of sections of pipelines No. 5 and 8 running through the penetrations and which are subject to reconstruction

Within the frame of the project for plant life extension of Kozloduy NPP Units 5 and 6, in 2017, non-contact magnetometric diagnostics was performed along the whole length of the concealed pipework. In accordance with the results from the assessment, recommendations have been made regarding the digging and a further survey of the concealed pipework sections with registered anomalies.

The activities for the digging and the further survey of the concealed pipework sections with registered anomalies have been performed as per the "Programme for survey of concealed pipework for service water of the QF system", developed by Kozloduy NPP. Compromised sections have been replaced and recommendations for ensuring the operability, resource characteristics and reliability of the concealed pipework have been implemented. The performed preventive control for establishment of compromised sections in the pipework and their timely maintenance ensured elimination of established defects and implementation of the safety functions to provide service water to the essential consumers of Units 5 and 6.

Measure No 8: Inclusion of boric acid corrosion as a potential degradation mechanism in case of contact with the external surface of the reactor pressure vessel and top closure head in the new revision of the Ageing Management Programme for the reactor pressure vessels of Units 5&6 at Kozloduy NPP

Boric acid is a potential degradation mechanism for carbon and low alloy steels upon contact with the outer surface of the reactor and the vessel head lid during operation of the reactor plant, and depends on the boric acid concentration. This could occur as a result of leakage from the flange connections of the control rod nozzles and the temperature control of the vessel head.

The "Ageing Management Programme for the RPVs of Units 5 and 6 of Kozloduy NPP" was updated and the boric acid influence as a potential degradation mechanism upon contact with the outer surface of the reactor vessel and the vessel head lid was included.

3. TABLE: SUMMARY OF THE PLANNED ACTIONS

No	Installation	Thematic	Finding	Planned action	Deadline	Status
1.	NRA	Overall AMP	Item 2.1.4 Bearing in mind the comprehensive nature of the activities related to ageing management, and in order to improve their effectiveness, it is required to review the processes on the grounds of which a long-term inspection programme of the NRA is developed.	Optimise the scope of the NRA inspection programme in terms of the type of SSCs and periodicity of their inspection.	December 2020	Completed
2.	Kozloduy NPP	Overall AMP	Item 3.1.1 TPR expected level of performance: Area for improvement: Methodology for scoping of SSCs subject to ageing management: The scope of comprehensive AMPs is reviewed and, if required, they are updated in compliance with the latest IAEA Safety Standards published.	Review and update of the list of structures and components within the range of the ageing management system in compliance with the requirements resulting from the latest issued IAEA guidelines on Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants, Specific Safety Guides, SSG-48.	December 2020	Completed
3.	Kozloduy NPP	Electrical cables	Item 4.1 TPR Good practice: Cables are aged within the actual power plant environment and tested to assess the cable condition and determine their residual lifetime.	The 0.4kV low voltage cables from the systems important to safety (low voltage cables located in MILD environment) shall be assessed to determine their residual lifetime.	December 2021	In progress

No	Installation	Thematic	Finding	Planned action	Deadline	Status
4.	Kozloduy NPP	Electrical cables	Item 4.6 TPR expected level of performance: consideration of uncertainties in the initial environmental qualification: The accuracy of the representation of the stressors used in the initial environmental qualification is assessed with regard to the expected stressors during normal operation and design basis accidents.	Requalification of 0.4 kV low voltage cables subject to LOCA and HELB qualification, using, when possible, estimations to reduce uncertainties.	December 2027	Planned
5.	Kozloduy NPP	Electrical cables	Item 4.7 TPR expected level of performance: determination of cables' performance under the impact of the strongest stressors: The cables necessary to mitigate the effects of accidents are tested to determine their ability to perform their functions under the conditions of extended beyond design basis accident conditions and throughout their expected life cycle.	The cables necessary to mitigate the effects of accidents are qualified to determine their ability to perform their functions under the conditions of extended Beyond Design Basis Accident (BDBA) Conditions and throughout their expected life cycle.	December 2028	Planned
6.	Kozloduy NPP	Concealed pipework	Item 2.3.1 Reconstruction is required of the penetration of pressure pipeline No 5 in the wall of shaft III 657 to ensure the necessary radial gap on both	Reconstruction of the penetration of pipelines Nos. 5 and 8 from the QF essential service water supply system	December 2020	Completed

No	Installation	Thematic	Finding	Planned action	Deadline	Status
			sides of the pipe. Item 2.3.1 Reconstruction is required of the penetration of pressure pipeline No 8 in the wall of the dosimetric control manhole of system III at unit 6, to ensure the necessary radial gap on both sides of the pipeline.			
7.	Kozloduy NPP	Concealed pipework	Item 2.3.2 Implementation of the recommendations to ensure the availability, lifetime characteristics and reliability of the main underground pipelines of the QF system at Units 5&6 of Kozloduy NPP according to the Conclusions on the technical condition and residual lifetime of the main underground pipelines of the QF system at Units 5&6 of Kozloduy NPP.	1. Excavation and additional assessment of the section of concealed pipework with anomalies identified by the contactless magnetometric diagnostics. 2. Assessment of sections of pipelines No. 5 and 8 running through the penetrations and which are subject to reconstruction.	December 2020	Completed
8.	Kozloduy NPP	Reactor Pressure Vessel	Item 3.3.3. The ageing management programme does not include boric acid corrosion as a potential degradation mechanism in case of contact with the external surface of the reactor pressure vessel and top closure head.	Inclusion of boric acid corrosion as a potential degradation mechanism in case of contact with the external surface of the reactor pressure vessel and top closure head in the new revision of the Ageing Management Programme for the reactor pressure vessels of Units 5&6 at Kozloduy NPP.	December 2019	Completed