ENSREG 1st TOPICAL PEER REVIEW

NATIONAL ACTION PLAN OF THE SLOVAK REPUBLIC

ON AGEING MANAGEMENT

UJD SR, Bratislava, Slovakia, September 2019

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0. ACRONYMS

AMP - Ageing Management Programme
BWR - Boiling Water Reactor
CADAK - Cable Ageing Database and Knowledge
EQ - Equipment Qualification
ESW - Essential Service Water
EU - European Union
IAEA - International Atomic Energy Agency
IGALL - International Generic Ageing Lessons Learned
HWC - Hydrogen Water Chemistry
IPZK - Individual Programme for Quality Assurance
ISFS - Interim Spent Fuel Storage
LRA - Linear Resonance Analysis
LTO - Long Term Operation
MOV - Motor Operated Valve
NAcP - National Action Plan
NAR - National Assessment Report
NEA - Nuclear Energy Agency
NDT - Non-Destructive Testing
NF - Nuclear Facility
NPP - Nuclear Power Plant
OAMP - Overall Ageing Management Programme
PSA - Probabilistic Safety Assessment
PSR - Periodic Safety Review
PWR - Pressure Water Reactor
RPV - Reactor Pressure Vessel
R&D - Research and Development
SSC - Structures, Systems and Components
TDR - Time Domain Reflectometry
TPR - Topical Peer Review
TSO - Technical Support Organisation
UJD SR - Urad jadroveho dozoru SR (Nuclear Regulatory Authority of the Slovak Republic)
WANO - World Association of Nuclear Operators
WG - Working Group

1. Introduction

This national action plan has been prepared in the frame of first Topical Peer-Review (TPR), which arises from the European Union's Nuclear Safety Directive 2014/87/EURATOM of 8 July 2014 amending Directive 2009/71/EURATOM on the establishment of a Community framework for the nuclear safety of nuclear installations of the European Union. The directive requires Member States of the European Union to conduct the TPR every six years with the first evaluation in 2017. The "Ageing Management" has been decided as the topic for the first TPR.

The TPR process aims to:

a) Enable participating countries to review their measures for ageing management of the NPPs, to identify good practice and areas for improvement;
b) Conduct a European peer review, share operating experience and identify common challenges facing the EU Member States;
c) Provide an open and transparent framework for participating countries to identify appropriate follow-up actions to remedy areas for improvement.

First phase of the TPR is evaluation of ageing management of nuclear facilities and preparation of a National Assessment Report (NAR) for each individual country involved in the TPR. The aim of the NAR is to:

a) Describe the overall ageing management programme (OAMP), including programme aspects, the implementation of the OAMP and the experience from the ageing management application;
b) Evaluate outputs and identify the main strengths and weaknesses;
c) Identify measures to address any significant areas for improvement;
d) Prepare a sufficiently detailed report in a specified format to allow a meaningful peer review.

The NAR was prepared in 2017 by Nuclear Regulatory Authority of the Slovak Republic (UJD SR) in close cooperation with the joint stock company Slovenské elektrárne, a. s. (SE, a. s.), based on relevant legislation in Slovakia and documents supplied from SE, a. s.

The NAR describes the methodology, procedure and results obtained from the evaluation of ageing management at six VVER 440 units located at two sites and forming three nuclear power plants in Slovakia: Bohunice V2 (EBO V2) and Mochovce Units 1 and 2 (EMO) which are in operation, and Mochovce Units 3 and 4 (MO34) which are under construction.

The evaluation covers the following areas applicable to NPPs in Slovakia):

- Overall ageing management programme (OAMP);
- Electric cables;
- Concealed pipework;
- Reactor pressure vessels (RPVs);
- Concrete containment structures.

The owner and holder of a license for the operation of all nuclear units in operation and units under construction is SE, a. s. The regulatory authority performing the supervision of nuclear safety of nuclear installations is UJD SR.

The second phase of the TPR is the development of the National Action Plan (NAcP). The NAcP provides explanations for the individual findings identified within the TPR process and, where further action is needed to eliminate these findings, these are described below.

The current Slovak NAcP has been prepared in accordance with ENSREG recommendations in the following structure and with the following content:

The introduction describes in general the preliminaries and the structure of the NAcP. Chapter 2 describes the result of national self-assessments. Chapter 3 contains the country-specific findings of the EU TPR Review Report for Slovakia, a brief description of the situation in the area and measures taken. Chapter 4 provides the domestic practice to meeting the required levels in the TPR review process in the Electrical cables area. Chapter 5 presents the domestic practice of other general findings highlighted in the TPR process. Chapter 6 outlines the domestic ageing management practices in the interim spent fuel storage facility (ISFS), which is outside the defined scope of the TPR review process. Chapter 7 contains a summary table of the decided actions.

The Action Plan aims to achieve progress in relation to the identified findings through the proposed measures.

2. FINDINGS RESULTING FROM THE SELF-ASSESSMENT

2.1. Overall Ageing Management Programmes (OAMPs)

2.1.1. State finding n°1 (area for improvement or challenge) from the self-assessment

During the preparation of the NAR, the following finding was identified through self-assessment - shortcomings in the SSCs drawing documentation in relation to the actual situation. This was classified as a challenge. This finding was also identified in the PSR carried out in 2016, classified as finding with low safety significance. The inspection revealed some shortcomings in the drawing documentation of the diesel generator station pipeline routes. The finding was identified on the basis of the criterion - licensee applies knowledge from general data on SSCs - taken from national legislation in the AMP preparation and implementation.

2.1.2. Country position and action on finding n°1 (licensee, regulator, justification)

In order to address the identified finding, the licensee proposed an integrated corrective measure PSR.13 to supplement and update the missing drawing documentation. This measure is a part of the regulation “Plan of implementation of corrective measures from the PSR carried out for NPP EBO V2 2016” adopted by the licensee's management on 22 October 2018.

2.1.3. State finding n°2 (area for improvement or challenge) from the self-assessment

During the preparation of the NAR, the following finding was identified through self-assessment - a non-continuous update of the ageing management database to reflect the actual condition of SSCs and knowledge. This was classified as a challenge. This non-compliance with requirements of UJD SR Safety Guide No. I.9.2/2014 (Ageing Management in NPPs) was identified by regulatory inspection of ageing management programmes which was carried out in 2017. Subsequently this non-compliance was applied in formulation of remedial measures in the PSR.

2.1.4. Country position and action on finding n°2 (licensee, regulator, justification)

An integrated corrective measure PSR.83 was formulated to address the identified non-compliance with the aim of modifying the ageing management database (software application) to allow more efficient use of data collected in the ageing management process and to reflect the actual condition of SSCs and current knowledge. The proposed corrective measure is to upgrade the existing database. This measure is a part of the regulation “Plan for implementation of corrective measures from the PSR carried out for EBO V2 2016” adopted by the licensee's management on 22 October 2018.

2.2. Electrical cables

2.2.1. State finding (area for improvement or challenge)-from the self-assessment

Not identified.

2.2.2. Country position and action on finding (licensee, regulator, justification)

N/A

2.3. Concealed pipework

2.3.1. State finding (area for improvement or challenge) from the self-assessment

Not identified.

2.3.2. Country position and action on finding (licensee, regulator, justification)

N/A

2.4. Reactor pressure vessel

2.4.1. State finding (area for improvement or challenge) from the self-assessment

Not identified.

2.4.2. Country position and action on finding (licensee, regulator, justification)

N/A

2.5. Concrete containment structure and pre-stressed concrete pressure vessel

2.5.1. State finding (area for improvement or challenge) from the self-assessment

Not identified.

2.5.2. Country position and action on finding (licensee, regulator, justification)

N/A

3. COUNTRY SPECIFIC FINDINGS RESULTING FROM THE TPR

3.1. Overall Ageing Management Programmes (OAMPs)

3.1.1. TPR expected level of performance: finding 1

Delayed NPP projects and extended shutdown: During long construction periods or extended shutdown of NPPs, relevant ageing mechanisms are identified and appropriate measures are implemented to control any incipient ageing or other effects.

3.1.2. Country position and action (licensee, regulator, justification)

Methodical guide for the overall ageing management programme (OAMP) as well as individual AMPs is also valid for MO34 units under construction. A list of SSCs for ageing management of MO34 units is also prepared.

Within the completion of the nuclear units of the MO34 NPP, the requirements related to SSCs ageing management were taken into account at all stages of the design. This was done as a part of the revision of the initial design and also by developing safety concepts for the most commonly occurring degradation mechanisms. These concepts included the specifics of the MO34 NPP design and experience from the implementation of the AMP at the EBO V2 and EMO NPPs. In the implementation design phase, specific projects of those supplies that were necessary for the implementation of individual AMPs were developed.

Relevant information on this topic was provided in NAR - Section 2.3.1.2 and 2.3.1.3 and in Answers of Slovakia - row 2183.

Action 1:

In order to achieve progress in identifying degradation mechanisms and managing ageing effects for delayed construction projects and extended shutdowns, the Licensee shall revise the OAMP as well as the existing ageing management programmes for each SSC. The revision will address, inter alia, the following areas - definitions (delayed construction periods, prolonged outages, extended shutdown, and post-final shutdown), ways of identifying, detecting and monitoring potential degradation mechanisms as well as preventive actions to prevent and minimize the effects of ageing. The output of the ongoing IGALL WG5 project focused on delayed construction periods, prolonged outages, extended shutdown and post final shutdown will also be used as a basis for documents revision.

3.2. Concealed pipework

3.2.1. TPR expected level of performance:

No Area for Improvement was identified for Slovakia in the concealed pipework area.

3.2.2. Country position and action (licensee, regulator, justification)

N/A

3.3. Reactor pressure vessel

3.3.1. TPR expected level of performance:

No Area for Improvement was identified for Slovakia in the reactor pressure vessel area.

3.3.2. Country position and action (licensee, regulator, justification)

N/A

3.4. Concrete containment structure and pre-stressed concrete pressure vessels

3.4.1. TPR expected level of performance:

No Area for Improvement was identified for Slovakia in the area of concrete containment structures.

3.4.2. Country position and action (licensee, regulator, justification)

N/A

4. GENERIC FINDINGS RELATED TO ELECTRICAL CABLES

4.1. Good practice: characterize the state of the degradation of cables aged at the plant

Cable ageing takes place in the actual power plant environment and tested to assess cable condition and determine residual lifetime.

4.1.1. Country implementation

The licensee has established a cable deposit programme which forms an integral part of the cable AMP. Cable deposit activities consist of preparation, installation, periodic sampling and evaluation of samples of representative types of cables placed in selected plant hot spots (locations). The cable samples are placed in location mostly exposed to heat and radiation exposed locations (steam generator box, emergency core cooling room valves, piping area at +14.7 m). The effects of degradation mechanisms are monitored through the changes of mechanical, thermo-oxidation and electrical properties. The results obtained on the cable samples are trended and compared with the acceptance criteria given in the AMP or with data obtained during initial cable qualification.

The programme is implemented at the operated units of the EMO NPP (since 1999–2001) and at the EBO V2 NPP (since 2002–2004). As of December 2018, the total number of samples in cable deposit is 34 pcs in EBO-V2 and 115 pcs in EMO12 NPP. Number of samples is continually updated, e.g. in case of cable replacement.

Due to the quantification of environmental stressors affecting cables and the use of cable deposit for requalification purposes, monitoring of environmental parameters (temperature, radiation, and relative humidity) has been introduced in the cable deposit locations.

At the NPP under construction (MO34) the implementation of cable deposit is under preparation. In 2018 and 2019 the selection and obtaining of cables samples into the deposit for Unit 3 was carried out as well as tests of the initial condition of the cables. The deposit will be installed on both units before the start of the plant operation.

Out of the cable deposit also cables samples removed from operation are used for the purpose of evaluation of cables condition and testing.

Relevant information on cable deposit was provided in NAR - Section 3.1.1, Tab. 3-4, Section 3.1.2 and 3.1.3.

4.1.2. Country planned action if relevant

By means of a cable deposit programme and cables removed from the operation, the licensee uses cables aged under actual plant conditions to test and evaluate the condition of the cables. No further actions are planned in this area.

4.2. TPR expected level of performance: documentation of the cable ageing management programme

The AMP is sufficiently well-documented to support any internal or external reviews in a fully traceable manner.

4.2.1. Country implementation

AMP cable documentation consists of:

- Methodical guide JE/NA-344.02-11 Cable Ageing Management Programme,
- List of SSCs for ageing management - separate document for each NPP,
- Cable databases for each NPP

- Results of partial programmes (cable deposit, measurement of functional cables in operation, monitoring of environmental parameters, visual inspections).

This documentation can be found in:

- Printed version - such as ISM documentation, internal reports, technical reports from the supplier
- Electronic form - on a network drive (docs + pdf documents; data in xls format).

The licensee operates the ageing management database which contains the CABLE module where the following data relevant to the AMP are stored:

- General data (data sheets, construction, materials, operating characteristics, etc.),
- Environmental parameters - temperature, radiation dose - in the rooms where the cables are located (design and actual - if available),
- Results (protocols) from operational measurements (revision measurements),
- Qualification protocols, results of accelerated ageing;
- Reports from partial programmes (cable deposit, measurement of functional cables in operation),
- Results from partial programmes, test reports (accredited laboratory).

Relevant information on this topic was provided in NAR - Section 2.3.1.2, 2.3.2.3 and during the discussion at WS in Luxembourg in May 2018.

4.2.2. Country planned action if relevant

Cable AMP is well documented and no further actions are planned in this area.

4.3. TPR expected level of performance: methods for monitoring and directing all AMP-activities

Methods to collect NPP cable ageing and performance data are established and used effectively to support the AMP for cables.

4.3.1. Country implementation

The licensee has implemented an AMP, which defines the methods and data that are collected to monitor cables condition. In addition to partial programmes performed within AMP (cable deposit, measurement of functional cables in operation, environmental qualification, monitoring of environmental parameters), information from regular revision measurements performed on cables also enter the AMP. The way in which these data are collected, processed and stored is also set. In order to process and store cable status information, the licensee has created and operates an ageing management database where a separate CABLE module is created for the cables.

Relevant information on this topic was provided in NAR - Section 2.3.2.3 and during the discussion at WS in Luxembourg in May 2018.

4.3.2. Country planned action if relevant

The licensee has set up a system for monitoring and collecting relevant cable condition data within the AMP and no further actions are planned in this area.

4.4. TPR expected level of performance: Systematic identification of ageing degradation mechanisms considering cable characteristics and stressors

Degradation mechanisms and stressors are systematically identified and reviewed to ensure that any missed or newly occurring stressors are revealed before challenging the operability of cables.

4.4.1. Country implementation

The systematic identification of the degradation mechanisms and stressors to which cables are exposed in real operation began in 1998–2001 as part of the R&D project "Monitoring of Qualified Life and Ageing Assessment of Electrical and I&C Equipment". Slovakia—through the licensee—is involved in the IAEA IGALL WG2 project (Electrical and I&C Components Working Group), which provides a platform for sharing the best international practices and experience of IGALL member countries in the field of ageing management and environmental qualification, including identification of degradation mechanisms (subgroup „Cables“ and “Environmental Qualification”). In addition, the licensee was involved in the OECD/NEA CADAK (Cable Ageing Database and Knowledge) project in 2013–2018. Licensee' representatives also participate as experts in the IAEA international workshops that provide space for sharing information and experience with other operators.

On a yearly basis, the licensee meets representatives of the operator and technical support organisations (TSO) from the Czech Republic with the aim of exchanging experience in the area of ageing management and long term operation.

In order to benefit from operating experience, the licensee has implemented the process of Operating Experience Utilization which covers operating events from all the operator's power plants, international sources (IAEA-IRS, WANO, EPRI), UJD SR, operator in the Czech Republic, other R&D organizations as well as and other industry.

Identification and quantification of environmental stressors on cables is carried out by monitoring of environmental parameters and identification of hot spots, which are carried out by the licensee systematically at all operated units. Environmental monitoring includes monitoring of temperature, radiation dose and relative humidity.

Relevant information on this topic was provided in NAR - Sections 2.3.2.2, 3.1.1, and 3.2 and in Answers of Slovakia - row 898.

4.4.2. Country planned action if relevant

Systematic identification of degradation mechanisms and cable stressors is carried out and adequately managed by the licensee through several activities (membership in international projects, monitoring of environmental parameters, operating experience application, etc.). No further actions are planned in this area.

4.5. TPR expected level of performance: prevention and detection of water treeing

Approaches are used to ensure that water treeing in cables with polymeric insulation is minimised, either by removing stressors contributing to its growth or by detecting degradation by applying appropriate methods and related criteria.

4.5.1. Country implementation

The highest voltage level of cables with polymer insulation is 6 kV at NPPs in Slovakia. All these cables are operated in an environment without direct contact with water (not submerged). Only cables placed in external underground cable ducts (between civil structures) are exposed to increased humidity, but they are also operated within the operating limits of the cables. The relative humidity values in these areas are monitored within the monitoring of environmental parameters. To minimize the possibility of water intrusion into the cable ducts, the manholes in the cable ducts are equipped with protective covers that are regularly inspected during the plant walk downs.

The phenomenon of water tree formation is manifested especially in cables with XLPE insulation. 6 kV cables with XLPE insulation are minimally represented at NPPs in Slovakia, as most 6 kV cables are PVC insulated. XLPE insulated cables in external cable ducts are designed to prevent the ingress of water (2x water blocking tape, double coating). Other XLPE insulated cables are installed in a dry environment. In addition, all types of XLPE insulation operated at NPPs are included in the programme “Measurement of functional cables in operation”, where their condition is monitored by the means of insulation condition monitoring, measurement of polarization index, capacity and LIRA (Line Resonance Analysis) signature; TDR (Time Domain Reflectometry), methods respectively.

Relevant information on this topic was provided in NAR – Section 3.1.2 and in Answers of Slovakia – row 1774.

4.5.2. Country planned action if relevant

Minimizing of water trees formation on cables is managed by a combination of measures for elimination of moisture effects (placing cables in low-exposed areas, minimizing water penetration into cable ducts), the cable types used (minimum XLPE insulated cables, water blocking cable construction) and by the means of monitoring of selected electrical parameters on these cables.

No further actions are planned in this area.

4.6. TPR expected level of performance: consideration of uncertainties in the initial EQ

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.

4.6.1. Country implementation

Cables requiring functionality during an accident are qualified for the given environmental conditions. Current condition of the cables is assessed through the AMP and is compared with the results obtained during the environmental qualification. Thus the evaluation of the representativeness of the test sequence used in the initial qualification is indirectly evaluated through margins between the actual cable condition and the condition obtained during the environmental qualification by simulating normal operation (age-conditioning). Samples placed in a cable deposit are used for this purpose.

In case of environmental qualifications for new cables, a conservative value (between minimum and average value) is used for the selection of activation energy.

The identification and quantification of cable stressors is carried out by monitoring of environmental parameters. The actual temperature values in the cable locations are an important input for cable requalification purposes.

Relevant information on this topic was provided in NAR - Sections 3.1.2 and during the discussion in workshop in Luxembourg in May 2018.

4.6.2. Country planned action if relevant

The evaluation of the representativeness of the test sequence used in the initial qualification is indirectly evaluated by comparing the actual condition of the cable to the condition obtained during the initial qualification for normal environmental conditions (age-conditioning). Samples placed in a cable deposit are used for this purpose.

No further actions are planned in this area.

4.7. TPR expected level of performance: determining cables’ performance under highest stressors

Cables necessary for accident mitigation are tested to determine their capabilities to fulfil their functions under Design Extension Conditions and throughout their expected lifetime.

4.7.1. Country implementation

Cables important to safety—which are required to be qualified—are qualified for normal and accident conditions considered at location of their installation. Environmental monitoring is performed to confirm that the actual conditions (temperature and radiation dose) are in accordance with the conditions used in the initial qualification. The actual condition of the cables is periodically evaluated within the cable deposit programme, and the condition of the cable qualification is verified by measuring the elongation. Installed cables that have actually been aged in operation are used for further testing. Cables that are required to perform their safety functions under design extension conditions are qualified to those conditions. To assess the condition of the cables, a combination of different methods is used - electrical, mechanical, thermo-oxidation properties and indenter module.

Relevant information on this topic was provided during the discussion in workshop in Luxembourg in May 2018.

4.7.2. Country planned action if relevant

No further actions are planned in this area.

4.8. TPR expected level of performance: techniques to detect the degradation of inaccessible cables

Based on international experience, appropriate techniques are used to detect degradation of inaccessible cables.

4.8.1. Country implementation

Cables that are not accessible for visual inspection can be considered as inaccessible cables; i.e. cables sprayed with fire-resistant coating and bottom cables on cable trays covered with other cables. Within AMP, the evaluation of cables in operation (i.e. cables to selected load such as 6 kV, 0.4 kV electric motors, MOV, transformers, measuring circuits etc.) is performed through the measurement of selected electrical parameters such as insulation resistance, polarization index, capacity and TDR (Time Domain Reflectometry). The TDR method was used in 2001–2018 and since 2019 the Linear Resonance Analysis (LIRA) method has been used. The scope of cables measured in this way also includes cables that are not available for visual inspection – inaccessible cables.

Relevant information on this topic was provided in NAR - Sections 3.1.3, then in Answers of Slovakia – rows 899, 1772 and during the discussion in WS in Luxembourg in May 2018.

4.8.2. Country planned action if relevant

The evaluation of inaccessible cables is carried out by measurement of selected electrical parameters on "functional cables in operation", i.e. cables to selected load (6 kV, 0.4 kV electric motors, MOV, transformers, measuring circuits, etc.).

No further actions are planned in this area.

5. ALL OTHER GENERIC FINDINGS

5.1. Overall Ageing Management Programmes (OAMPs)

5.1.1. Good practice: External peer review services

External peer review services (e.g. SALTO, OSART-LTO, and INSARR-Ageing) are used to provide independent advice and assessment of licensees' ageing management programmes.

5.1.1.1. Allocation by the TPR

This finding was classified for Slovakia as a Good Performance.

5.1.1.2. Country position

All operated NPPs in Slovakia were subject of many independent international peer reviews. Since 1991 there have been more than twenty IAEA peer review missions (site, project, OSART and IPSART), several WANO peer review missions, two RISKAUDIT review missions and one WENRA review mission. In 2010, the OSART mission—that was extended by the LTO module—at EBO-V2 NPP focused specifically on LTO issues.

The fact that AMPs are developed for 60 years of plant operation has been classified as a good practice by the WANO Peer Review mission at EMO NPP in 2013 and by the OSART mission (extended with LTO module) at EBO V2 NPP in 2010.

Licensee' representatives participate in SALTO peer review missions as observers. Information on external audits is given in the NAR (Section 2.3.2.6 and Summary).

5.1.2. TPR expected level of performance: Data collection, record keeping and international cooperation

Participation in international R&D projects, experience exchange within groups of common reactor design and the use of existing international databases are used to improve the effectiveness of the NPPs OAMP.

5.1.2.1. Allocation by the TPR

This finding was classified for Slovakia as a Good Performance.

5.1.2.2. Country position and action

Slovakia is involved in the IAEA IGALL project, which provides a platform for sharing the best international practices and experience of IGALL member countries in the area of ageing management and long term operation. Within the IGALL project Slovakia is involved in all working groups: WG1 (mechanical components), WG2 (Electrical and I&C Components), WG3 (Civil structures), WG4 (Guidance for regulators) and WG5 (Delayed construction period and extended outages). In addition, the licensee is involved in OECD/NEA CODAP (Component Operational Experience, Degradation and Ageing Programme) project and in 2013–2018 also in the Cable Ageing Database and Knowledge (CADAK) project. Licensee' representatives also participate as experts in the IAEA international workshops that provide space for sharing information and experience with other operators.

On a yearly basis, the licensee meets representatives of the operator and TSO from the Czech Republic with the aim of exchanging experience in the area of ageing management and long term operation.

Relevant information on this topic was provided in NAR - Section 2.3.2.5 and 2.3.2.6.

No further actions are planned in this area.

5.1.3. TPR expected level of performance: Methodology for scoping the SSCs subject to ageing management

The scope of the OAMP for NPPs is reviewed and, if necessary, updated, in line with the new IAEA Safety Standard No. SSG-48 "Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants" (2018).

5.1.3.1. Allocation by the TPR

This finding was classified for Slovakia as a Good Performance.

5.1.3.2. Country position and action

The scope of the SSC for ageing management and the long term operation programme in Slovakia is given by national legislation in which the international IAEA approach is incorporated. List of SSCs for ageing management is developed for each NPP. The completeness of the List of SSC for Ageing Management is part of the review of Area 4 "Ageing Management" within the PSR. No findings were identified in this topic during the last PSR at EBO V2 NPP in 2016 and EMO NPP in 2018.

Selection of SSCs for ageing management contains:

- Equipment performing safety functions important to safety - this group of SSCs is fully included by the scope of Safety Class I–III equipment in accordance with the legislation in Slovakia on classification of selected equipment into safety classes,
- Equipment that help mitigate certain types of events whose function has resulted from safety analyses;
- Equipment important for long term operation – following a licensee special request.

The scope of equipment for ageing management also includes equipment needed to handle operating events associated with the Design Extension Conditions, as these are classified in Safety Class III.

Relevant information on this topic was provided in NAR - Sections 2.3.1.3, then in Answers of Slovakia – row 1873 and during the discussion at WS in Luxembourg in May 2018.

No further actions are planned in this area.

5.1.4. TPR expected level of performance: Delayed NPP projects and extended shutdown

During long construction periods or extended shutdown of NPPs, relevant ageing mechanisms are identified and appropriate measures are implemented to control any incipient ageing or other effects.

5.1.4.1. Allocation by the TPR

This finding was classified for Slovakia as Area for Improvement.

5.1.4.2. Country position and action

Methodical guide for ageing management (OAMP) as well as individual AMPs is valid for MO34 units under construction as well. A list of SSCs for ageing management of MO34 has also been prepared.

Within the completion of the MO34 NPP, the requirements related to SSCs ageing management were taken into account at all stages of the design. This was done as part of the revision of the initial design and also by developing safety concepts for the most commonly occurring degradation mechanisms. These concepts included the specifics of the MO34 NPP design and experience from the AMP implementation at the EBO V2 and EMO NPPs. In the implementation design stage, specific projects of those supplies necessary for the implementation of individual AMPs were developed (RPV surveillance, monitoring of temperature ageing of primary circuit materials, corrosion loop for monitoring of corrosion processes in primary circuit materials, monitoring of flow accelerated corrosion/erosion corrosion on secondary circuit components, cable deposit programme).

Additional visual inspections and non-destructive testing are carried out on the main mechanical SSCs before commissioning to verify that the degradation mechanisms have not developed.

Relevant information on this topic was provided in NAR - Section 2.3.1.2 and 2.3.1.3 and in Answers of Slovakia - row 2183.

Action 1:

In order to achieve progress in identifying degradation mechanisms and managing ageing effects for delayed construction projects and extended shutdowns, the Licensee shall revise the overall AMP as well as the existing ageing management programmes for each SSC. The revision will address, inter alia, the following areas - definition of terms (delayed construction periods, prolonged outages, extended shutdown, and post-final shutdown), ways of identifying, detecting and monitoring potential degradation mechanisms as well as preventive actions to prevent and minimize the effects of ageing. The output of the ongoing IGALL WG5 project focused on delayed construction periods, prolonged outages, extended shutdown and post-final shutdown will also be used as a basis for documents revision.

5.1.5. TPR expected level of performance: Overall Ageing Management Programmes of research reactors

A systematic and comprehensive OAMP is implemented for research reactors, in accordance with the graded approach to risk, the applicable national requirements, international safety standards and best practices.

5.1.5.1. Allocation by the TPR

Not applicable for nuclear installations in Slovakia.

5.1.5.2. Country position and action

Not applicable for nuclear installations in Slovakia.

5.2. Concealed pipework

5.2.1. Good practice: use of results from regular monitoring of the condition of civil structures

In addition to providing information on soil and building settlement, the results from regular monitoring of the condition of civil structures are used as input to the ageing management programme for concealed pipework.

5.2.1.1. Allocation by the TPR

This finding (Good Practice) has not been assigned to Slovakia.

5.2.1.2. Country position

Measurement of settlement is carried out at specified intervals on all civil structures where the SSCs classified in safety classes are placed. Furthermore, the condition and development of cracks are evaluated for civil structures. If deviations from the nominal condition are detected, the results of the monitoring of the civil structures represent the entry into the AMP for concealed pipework.

Relevant information on this topic was provided during the discussion at WS in Luxembourg in May 2018.

5.2.2. Good practice: performance checks for new or novel materials

In order to establish the integrity of new or novel materials, sections of pipework are removed after a period of operation and inspected to confirm the properties are as expected.

5.2.2.1. Allocation by the TPR

This finding (Good Practice) has not been assigned to Slovakia.

5.2.2.2. Country position

Design documentation of SSC classified in safety classes, including used materials, is subject to approval by the regulatory authority. The use of non-metallic materials for safety piping, including buried pipelines, is not permitted at NPPs in Slovakia. In the event of possible future use of “new” types of materials, their condition will be assessed in terms of the inspection and testing plan.

Relevant information on this topic was provided during the discussion at WS in Luxembourg in May 2018.

5.2.3. TPR expected level of performance: inspection of safety-related pipework penetrations

Inspection of safety-related pipework penetrations through concrete structures are part of ageing management programmes, unless it can be demonstrated that there is no active degradation mechanism.

5.2.3.1. Allocation by the TPR

This finding was classified for Slovakia as a Good Performance.

5.2.3.2. Country position and action

The piping penetrations passing through the concrete walls form part of the pipelines in which the ageing management is management by the existing AMP or other plant programmes. From the point of view of degradation mechanisms, there is no reason to assume that on the internal surface of the piping a different degradation mechanism will operate at the transition point than in other parts of the pipeline. Degradation mechanisms that are covered by the existing AMPs include flow-accelerated corrosion/erosion-corrosion and corrosion monitoring. In addition, the condition of the piping is indirectly monitored through pressure tests and the condition of the penetrations themselves is checked by visual inspection.

Relevant information on this topic was provided in Answers of Slovakia – rows 1488, 1499, 2190 and during the discussion at WS in Luxembourg in May 2018.

No further actions are planned in this area.

5.2.4. TPR expected level of performance: scope of concealed pipework included in AMPs

The scope of concealed pipework included in ageing management includes those performing safety functions, and also non-safety-related pipework whose failure may impact SSCs performing safety functions.

5.2.4.1. Allocation by the TPR

This finding was classified for Slovakia as a Good Performance.

5.2.4.2. Country position and action

The scope of the SSCs for ageing management and the long term operation programme in Slovakia is given by national legislation in which the international IAEA approach is incorporated. All concealed pipework that are important to safety are included in the AMP. A graded approach (safety class, operating conditions, PSA, outputs from the equipment reliability process, materials used, operating experience) is applied when a piping is selected for the AMP.

The condition monitoring of concealed pipework - including those whose failure may affect the safety function of the other SSCs - is also carried out through other power plant programmes such as in-service inspection programme, functional testing and surveillance, maintenance, water chemistry management.

Relevant information on this topic was provided in NAR - Sections 2.3.1.3, 4.1.1.2, then in Answers of Slovakia – row 1490 and during the discussion in workshop in Luxembourg in May 2018.

No further actions are planned in this area.

5.2.5. TPR expected level of performance: opportunistic inspections

Opportunistic inspection of concealed pipework is undertaken whenever the pipework becomes accessible for other purposes.

5.2.5.1. Allocation by the TPR

This finding was classified for Slovakia as a Good Performance.

5.2.5.2. Country position and action

Replacement and rehabilitation of essential service water (ESW) pipelines was carried out at EBO V2 NPP in 2015–2016. Under this project, parts of the ESW piping that were excavated and accessible were inspected. If, for any reason, the concealed pipework is accessible for inspection in the future, the inspection will be carried out.

Relevant information on this topic was provided in NAR - Sections 4.1.3, 4.2 and during the discussion at WS in Luxembourg in May 2018.

No further actions are planned in this area.

5.3. Reactor pressure vessel

5.3.1. Good practice: Hydrogen water chemistry

Hydrogen Water Chemistry (HWC) is used in BWRs which may be sensitive to Intergranular Stress Corrosion Cracking

5.3.1.1. Allocation by the TPR

Not applicable for nuclear installations in Slovakia.

5.3.1.2. Country position

Not applicable for nuclear installations in Slovakia.

5.3.2. Good practice: Implementation of a shield

Shielding in the core of PWRs with relatively high fluence is implemented to preventively reduce neutron flux on the RPV wall.

5.3.2.1. Allocation by the TPR

Not applicable for nuclear installations in Slovakia.

5.3.2.2. Country position

Not applicable for nuclear installations in Slovakia.

5.3.3. TPR expected level of performance: Volumetric inspection for nickel base alloy penetration

Periodic volumetric inspection is performed for nickel base alloy penetrations which are susceptible to Primary Water Stress Corrosion Cracking for PWRs to detect cracking at as early a stage as possible.

5.3.3.1. Allocation by the TPR

Not applicable for nuclear installations in Slovakia.

5.3.3.2. Country position and action

Not applicable for nuclear installations in Slovakia.

5.3.4. TPR expected level of performance: Non-destructive testing in the base material of beltline region

Comprehensive NDE is performed in the base material of the beltline region in order to detect defects

5.3.4.1. Allocation by the TPR

This finding was classified for Slovakia as a Good Performance.

5.3.4.2. Country position and action

Requirements for performing non-destructive testing are specified in the national legislation. These requirements are then transformed into documentation and procedures for performance of in-service inspection. Exclusively only testing methods that are qualified according to the ENIQ (European Network for Inspection and Qualification) methodology are used. Regular NDT of the RPV includes the examination of the entire wall thickness of the pressure vessel, including the underclad layer. Inspection of welds and base metal in the beltline region is carried out around the entire perimeter of the pressure vessel. These inspections are carried out in four and eight-year intervals.

In 2013–2016, following the regulatory recommendations that result from findings at RPV in Doel and Tihange NPPs, the extended inspections were carried out along the whole core region to identify any potential indications of the character of hydrogen flakes.

The whole ISI process at NPPs in Slovakia is subject to approval and inspection by the regulatory authority.

Relevant information on this topic was provided in NAR - Sections 5.1.3.1.5, 2.3.2.4, and 2.3.3, then in Answers of Slovakia – row 2191 and during the discussion at WS in Luxembourg in May 2018.

No further actions are planned in this area.

5.3.5. TPR expected level of performance: Environmental effect of the coolant

Fatigue analyses have to take into account the environmental effect of the coolant.

5.3.5.1. Allocation by the TPR

This finding was classified for Slovakia as a Good Performance.

5.3.5.2. Country position and action

Following the latest knowledge, the impact of the environment on fatigue assessment is considered in AMPs. Assessment of RPV fatigue damage is carried out regularly at NPPs in Slovakia at annual intervals. The impact of the environment on fatigue is included in computational analyses in the form of predefined criteria in accordance with the VERLIFE methodology and the latest knowledge in this area.

Within the IGALL project, a separate group of VVER NPP operators was created. One of the three topics to be discussed is the issue of environmentally assisted fatigue. The first meeting will take place in January 2020 with the active participation of representatives from Slovakia.

Relevant information on this topic was provided during the discussion at WS in Luxembourg in May 2018.

No further actions are planned in this area.

5.3.6. TPR expected level of performance: Suitable and sufficient irradiation specimens

For new reactors, suitable and sufficient irradiation specimens and archive materials are provided to support the reactor throughout the entire plant operation.

5.3.6.1. Allocation by the TPR

This finding was classified for Slovakia as a Good Performance.

5.3.6.2. Country position and action

Currently two units are under construction in Slovakia at Mochovce plant site. For these units, specific projects of those supplies that were necessary for the implementation of individual AMPs (including the RPV surveillance) were developed in the implementation design stage. The RPV surveillance programme - is planned to cover the entire NPP life).

Relevant information on this topic was provided in NAR - Section 2.3.1.3 and during the discussion at WS in Luxembourg in May 2018.

No further actions are planned in this area.

5.4. Concrete containment structure and pre-stressed concrete pressure vessel

5.4.1. Good practice: monitoring of concrete structures

Complementary instrumentation is used to better predict the mechanical behaviour of the containment and to compensate for loss of sensors throughout the life of the plant.

5.4.1.1. Allocation by the TPR

This finding was classified for Slovakia as a Good Practice.

5.4.1.2. Country position

The condition of civil structures, including concrete structures, is evaluated in the AMPs by several methods such as crack growth assessment, the coating thickness measurement and the thickness measurement of the slab, the depth of concrete carbonation measurement, tightness and strength test of the containment, settling measurement, etc. Another additional method that has been introduced in the AMPs includes Geo Radar technique. Geo Radar is used as a complementary method for detecting concrete quality, the presence of moisture in concrete, cavity defects, etc.

Other activities in this area are of the nature of continuation in the current AMPs with maximum use of new complementary methods.

Relevant information on this topic was provided in NAR - Section 7.1.3 in Answers of Slovakia – rows 128, 1285 and during the discussion in workshop in Luxembourg in May 2018.

5.4.2. Good practice: assessment of inaccessible and/or limited access structures

A proactive and comprehensive methodology is implemented to inspect, monitor and assess inaccessible structures or structures with limited access

5.4.2.1. Allocation by the TPR

This finding (Good Practice) has not been assigned to Slovakia.

5.4.2.2. Country position

The condition of civil structures, including concrete structures, is evaluated in the AMPs by several methods such as crack growth assessment, the coating thickness measurement and the thickness measurement of the slab, the depth of concrete carbonation measurement, tightness and strength test of the containment, settling measurement, etc. Another additional method that has been introduced in the AMPs is to use the Geo Radar technique. Geo Radar is used as a complementary method for detecting concrete quality, the presence of moisture in concrete, cavity defects, voids in the nature of cavities, etc.

When modifications to the NPP are being performed, during which access to inaccessible parts of the concrete structure is possible, it also provides opportunities for inspection of these locations.

Relevant information on this topic was provided in NAR - Section 7.1.3 and in Answers of Slovakia - rows 128, 403, 1285 and during the discussion in workshop in Luxembourg in May 2018.

5.4.3. TPR expected level of performance: monitoring of pre-stressing forces

Pre-stressing forces are monitored on a periodic basis to ensure the containment fulfils its safety function.

5.4.3.1. Allocation by the TPR

Not applicable for nuclear installations in Slovakia.

5.4.3.2. Country position and action

Not applicable for nuclear installations in Slovakia.

6. STATUS OF THE REGULATION AND IMPLEMENTATION OF AMP TO OTHER RISK SIGNIFICANT NUCLEAR INSTALLATIONS

6.1. Board recommendation

The Board recommends that countries explore the regulation and implementation of Ageing Management Programmes of other risk significant nuclear installations while developing and implementing National Action Plans to ensure they exist and are effective.

6.2. Country position and action (fuel cycle facilities, installations under decommissioning, waste facilities, etc.)

The TPR Board recommended to ENSREG that countries explore the regulation and implementation of Ageing Management Programmes (AMP) of other risk significant nuclear installations while developing and implementing National Action Plans to ensure they exist and are effective.

Regarding this recommendation the ENSREG invited countries to address the AMPs of other significant nuclear installations on voluntary basis, Slovakia decided to briefly report on AMP of the Interim Spent Fuel Storage located at the Bohunice site.

The legal framework in the area of ageing management is valid for all nuclear installations in Slovakia using the graded approach.

The ISFS is a standalone building without any construction link to the buildings within the premises of other nuclear installations at Jaslovské Bohunice. The building is divided to container section and storage section. The storage section consists of 4 storage pools with one pool designated as a reserve pool. The storage pools are interconnected with a transport channel. Each pool can be separated from the transport channel with hydro locks. The spent fuel is stored inside baskets located in the pools under water, which at the same time is also a shielding and removes the residual heat from the spent fuel assemblies.

Based on the IAEA document (SSG-15 Storage of Spent Nuclear Fuel) and UJD SR Decision No. 152/2000, a monitoring program has been progressively implemented since 2001, focusing on:

- Building structures, such as the foundations of the ISFS building, concrete structures of spent fuel pools, supporting steel elements and structures, encasement of the ISFS building,
- Pressure vessels and piping systems (cooling, purification and decontamination system),
- Corrosive damage to equipment and technology that is in contact with the coolant for the spent fuel pools (construction of pools, transport equipment),
- Rotary machines (selected pumps and fans),
- Power supply systems and components (transformers, generators, motors and wiring),
- Spent nuclear fuel (shipping).

New monitoring points were installed to monitor settlement of the ISFS building, including monitoring of groundwater level. The ISFS pool lining condition is monitored by assessing the condition of material samples located in the pools and using the acoustic emission method. For monitoring the fuel condition, the Sipping in Pool system is used and inspection stands to monitor the fuel, where non-destructive checks of fuel rods are performed.

In order to ensure safe and reliable operation of the ISFS nuclear facility (NF) and in compliance with the UJD SR legislative requirements, the above-mentioned Decision (No. 152/2000) made this NF inter alia to develop and submit to UJD SR the programme of operational inspections of the conditions of:

- Civil and technological parts and systems of reconstructed ISFS having an impact on nuclear safety,
- Stored spent nuclear fuel.

This shall contain procedures of:

a) Visual inspection of the condition of the storage pools walls lining
b) Visual inspection of the total condition and defectoscopic inspection of selected welds of at least one predetermined and one randomly selected compact cask KZ-48 from each storage pool.

At the same time, the UJD SR imposed an obligation to inform the UJD SR in written form and at yearly intervals on results of monitoring programme and on total state of the ISFS.

The UJD SR requirements were met by developing a document „Programme of operational inspections of the ISFS equipment“, which is currently valid under the title 13-HMG-801.

The approved programme of inspections of designated equipment and constructions serves to provide and implement defined scope of operational inspections of equipment (components and systems) and condition of civil structures, technological systems and spent nuclear fuel stored in the interim spent fuel storage. The scope and performance of operational inspections is based on the requirements of Regulations of the UJD SR No. 430/2011 and No. 431/2011 as amended, IPZK and PK of individual selected equipment of ISFS, valid UJD SR decisions and programme „Monitoring of long-term service life of civil structures and technological systems of ISFS (PS M9-R)“. Due to complex overview the list of operational inspections also includes inspections, or requirements resulting from Regulation No. 508/2009 for classified technical equipment (gas, lifting, electric, pressure devices). The exact specification of devices undergoing inspection forms part of given programme, as well as determination of inspected places, scope, type and methods of inspections, frequency of their performance, criteria and methods for results evaluation.

The results of operational inspections of ISFS equipment are presented in the report on ISFS condition for respective calendar year which is regularly submitted to UJD SR pursuant to Decision of the UJD SR No. 444/2010.

6.2.1. Programme of operational inspections of ISFS equipment

Programme of operational inspections of the ISFS equipment includes:

- Monitoring of long-term service life of civil structures and technological systems of ISFS,
- Inspection of selected equipment and classified technical devices.

Monitoring of long-term service life of civil structures and technological systems of ISFS:

- Monitoring of ISFS transport equipment by a non-destructive testing method
- Monitoring of corrosion damage of civil structures and machinery and transport technology equipment - by a method of verification samples

  Monitoring programme by a method of verification samples forms part of the programme of permanent monitoring of corrosion status of the ISFS materials. The monitoring system used in case of wet storage of temporary storage of spent nuclear fuel from ISFS is based on high demands on long-term corrosion stability of construction materials used.

  The basic time interval of the inspection of samples in individual monitoring systems is 4 years.

- Monitoring of corrosion damage of civil structures and machinery and transport technology equipment – by acoustic emission testing method

Periodic measurements are performed as well as analysis of signals of acoustic emission from sensors installed on storage pools.

- Monitoring of stability and lifetime of civil structures – subsoil and foundation structures

  Inspection of stability of subsoil and ISFS bearing structures is provided by a system of repeated measurements of vertical and horizontal shifts, leanings and deformations in line with valid inspections programme.

- Monitoring of stability and lifetime of civil structures – pool part and bearing concrete structures

  Concrete strength values are set during control and standard inspection by concrete test hammer on the wall of a dry pool.

- Monitoring of stability and lifetime of civil structures – bearing metal parts and structures

  In line with the drawn up maps of steel structures thorough visual inspections of marked details of the bearing steel structure stare performed with the emphasis on:

  – Deflections and deformities of vertical and horizontal bearing elements of steel structure, the roof structure,

  – Details of the main bearing columns anchorage, etc.

- Monitoring of stability and lifetime of civil structures – external cladding and internal lining

  In line with the programme of inspections, the winter and summer measurement of parameters of the external cladding quality is being performed on the 53 measuring points.

- Device (Inspection stand) for fuel monitoring
- Monitoring of rotary machines
- Monitoring of electrotechnical equipment

  Planned inspections of insulation resistance measurement, electrical winding resistance measurement and measurement of current loading capacity at selected electrotechnical equipment.

Inspections of selected equipment and classified technical equipment

Besides monitoring of civil structures and technological systems, regular inspections and checks of selected equipment important from the viewpoint of nuclear safety are being performed (e.g.: pool water condensers, resin trap, etc.).

6.2.2. Conclusions

Formal requirement for monitoring of the state of civil and technological structures of the ISFS results from Decisions of the UJD SR No. 152/2000 and No. 444/2010. Apart from this, the operation license holder is obliged to meet requirements for maintenance of selected and classified equipment resulting from Regulations of the UJD SR No. 430/2011 and No. 431/2011 and Regulation of the Ministry of Labour, Social Affairs and family of the Slovak Republic No.508/2009. Management of ageing is also one of the inspected fields within the periodic assessment of nuclear safety.

Stated legislative requirements are implemented in operational and process documentation of the operation license holder where the methods and procedures of monitoring the condition of civil and technological ISFS structures are being described.

Pursuant to the above-mentioned legislative requirements, the operation license holder regularly submits to the UJD SR the following on a yearly basis:

- Programmes of operational inspections of selected ISFS equipment,
- Assessment of programmes of operational inspections of selected ISFS equipment,
- Report on the state of the ISFS.

Report on the state of the ISFS inter alia summarizes the results of the „Programme of Monitoring of long-term service life of civil structures and technological systems of ISFS “, that contains:

- Monitoring of ISFS equipment by a non-destructive testing method,
- Monitoring of corrosion damage of civil structures and machinery and transport technology equipment - by a method of verification samples,
- Monitoring of corrosion damage of civil structures and machinery and transport technology equipment – by acoustic emission testing method,
- Monitoring of stability and lifetime of civil structures – subsoil and foundation structures,
- Monitoring of stability and lifetime of civil structures – pool part and bearing concrete structures,
- Monitoring of stability and lifetime of civil structures – bearing metal parts and structures,
- Monitoring of stability and lifetime of civil structures – external cladding and internal lining,
- Monitoring of stored spent nuclear fuel state.

Slovakia has got the legislation base set for ageing management. The license holder is obliged to introduce and implement the programme of ageing management for identification of all ageing mechanisms related to systems, structures and components important from the viewpoint of safety.

The UJD SR performs regular inspections at holder of the license in order to verify the compliance with legislative requirements and good practice.

On the basis of the results of the ISFS equipment operational inspections which are presented in reports on ISFS status for respective calendar year, it can be concluded that all monitored values of measurements meet the acceptability criteria defined for individual equipment.

The ability of the ISFS systems, structures and components important from the viewpoint of nuclear safety, to fulfil their safety functions is considered assured by the UJD SR.

7. TABLE: SUMMARY OF THE PLANNED ACTIONS

Installation	Area	Finding	Planned action	Deadline	Regulator's Approach to Monitoring
NPP Bohunice	OAMP	Shortcomings in SSC drawing documentation in relation to the actual condition.	Add and update missing drawing documentation.	31 December 2020	
NPP Bohunice NPP Mochovce	OAMP	Non-continuous update of the ageing management database to reflect the actual condition of the SSCs and related knowledge.	Modification of the ageing management database to allow more efficient use of data collected in the ageing management process and to reflect the actual condition of SSCs and current knowledge of knowledge.	31 December 2023	
NPP Bohunice NPP Mochovce NPP MO34	OAMP, AMPs	During long construction periods or extended shutdown of NPPs, relevant ageing mechanisms are identified and appropriate measures are implemented to manage any incipient ageing or other effects.	In order to achieve progress in identifying degradation mechanisms and managing ageing effects for projects of delayed construction and extended shutdowns, the licensee shall revise the OAMP as well as the existing AMPs.	31 December 2021	