ENSREG
European Nuclear Safety Regulators Group

ENSREG 1st TOPICAL PEER REVIEW

NATIONAL ACTION PLAN OF THE SLOVAK REPUBLIC

ON AGEING MANAGEMENT

UPDATE

NUCLEAR REGULATORY AUTHORITY
OF THE SLOVAK REPUBLIC

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OBSAH

0 ACRONYMS

AMP	Ageing Management Programme
BWR	Boiling Water Reactor
CADAK	Cable Ageing Database and Knowledge
EQ	Equipment Qualification
EBO	Bohunice NPP units 3&4
EMO	Mochovce NPP units 1&2
MO34	Mochovce NPP units 3&4 – in commissioning/construction
ESW	Essential Service Water
EU	European Union
HWC	Hydrogen Water ChemistryIAEA International Atomic Energy Agency
IGALL	International Generic Ageing Lessons Learned
IPZK	Individual Programme for Quality Assurance
ISFS	Interim Spent Fuel Storage
JAVYS a.s.	Nuclear and Decommissioning Company
LIRA	Line Resonance Analysis
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
SE a.s.	joint stock company Slovenské elektrárne
TDR	Time Domain Reflectometry
TPR	Topical Peer Review
TSO	Technical Support Organisation
ESW	Essential Service Cooling Water
ÚJD SR	Nuclear Regulatory Authority of the Slovak Republic
WANO	World Association of Nuclear Operators
WG	Working Group

1 INTRODUCTION

The 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 (findings);
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 (ÚJD SR) in close cooperation with the joint stock company Slovenské elektrárne, a. s. (SE, a. s.), based on relevant legislation 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) and Mochovce Units 1 and 2 (EMO) which are in operation, and Mochovce Units 3 and 4 (MO34) which are under construction/commissioning.

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 power plants in operation and units under construction is SE, a. s. The Interim Spent Fuel Storage located at the Bohunice site is operated by JAVYS a.s.

The regulatory authority performing the supervision of nuclear safety of nuclear installations is ÚJD SR. The safety guide on ageing management of NPPS was reviewed to take into account the newest outcomes of IGALL and of TPR on ageing .

As TPR follow up ENSREG in November 2019 approved the ENSREG 1st Topical Peer Review Action Plan with the objective that each regulator will develop and make public its NAcP by the end of September 2019 for the related nuclear power plants and research reactors. For the other nuclear

installations , to report by the end of 2020 (or already in September 2019 on a voluntary bases). The updated NAcP provides explanations for the individual findings identified within the TPR process and where further action is needed explaines the actions taken.

The updated NAcP has been prepared in accordance with ENSREG decision (October 2019) 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 national practices of other general findings highlighted in the TPR process. Chapter 6 outlines national ageing management practices in relation to the interim spent fuel storage facility (ISFS) Chapter 7 contains a summary table of the decided actions.

The updated (2021) NAcP aims to demonstrate progress in implementing measures in relation to the identified findings to improve safety Updates of the TPR NAcP are due at the end of 2021 and 2023 respectively .

2 FINDINGS RESULTING FROM THE SELF-ASSESSMENT

2.1 Overall Ageing Management Programmes (OAMPs)

2.1.1 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 at EBO. 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.

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

In order to address the identified finding, the licensee proposed a corrective measure in order to supplement and update the missing drawing documentation as part of the PSR carried out at EBO.

Drawings of pipelines are performed for the purpose of measuring the wall thickness of pipelines and their components .

Some pipes are not part of ageing management programs. For these routes, the original drawing documentation is used (in the archive). For the purpose of pipeline monitoring by NDT ultrasonic measurement, the “as built” drawings are issued on the basis of the original drawing documentation and contains the designation (identification) of individual routes and components (fittings such as elbows, T-pieces, reducers, ...) and selected straight sections and their dimensions .

For the purposes of ageing management and to determine the condition of the ESW pipeline in the main production building (reactor building), the activities (including drawings) focused first on one ESW inlet system at each unit. Later on one ESW outlet system at each unit. Over the years, sufficient number of results of ultrasonic wall thickness measurements on these ESW systems have been received , which can be applied to other systems on the unit due to the redundancy of ESW system. The drawings of pipelines for the purpose of NDT measurements of wall thickness was elaborated according to the above procedure together with a plan of measurement of individual components during outages, including outages in 2021. Recently, wall thickness measurements focused on small bore pipes . Drawings of these remaining pipes will be realized gradually and in accordance with the requirements for measuring the wall thickness of other components of the ESW pipe.

For the purpose of ageing management, the first measurements of the wall thickness of the ESCW pipeline components from the turbine building to the individual diesel generators in the diesel generator station (DGS)including drawings were performed on components selected based on the results of stress analysis of pipelines at EBO. These were mostly components of larger dimensions, in the inseparable part of the pipeline, where unplanned leakage of media would jeopardize compliance with the requirements for ESCW pipelines as a safety class 3 component. Gradually, measurements were realised on pipes with smaller dimensions and oncomponents which could be separated in case of leakage.

As for the drawings of ESW pipelines within the DGS, they are under preparation because of the stepwise approach (prioritization) described above and also because several measurements have been made on these routes, which did not show that the wall thickness had decreased during operation. These are pipes of smaller diameters , It is expected that in the coming years, the remaining drawings for individual DGs will be gradually completed . This finding is considered to be completed based on the progress made.

ÚJD will monitor the remaining activities as part of the PSR action plan.

2.1.2 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 at both EBO and EMO. This was classified as a challenge. This non-compliance with ÚJD SR Safety Guide No. I.9.2/2014 (Ageing Management in NPPs) was identified by regulatory inspections of ageing management programmes. Subsequently this non-compliance was applied in formulation of remedial measure in the PSR for both NPPs .

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

Integrated corrective measures were 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 measures aims to upgrade the existing database. This measure is part of corrective measures identified during the PSRs carried out for EBO and EMO. The deadlines are 2022 for EBO and 2023 for EMO .

2.2 Electrical cables

2.2.1 Finding (area for improvement or challenge) from the self-assessment

Not identified.

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

N/A

2.3 Concealed pipework

2.3.1 Finding (area for improvement or challenge) from the self-assessment

Not identified.

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

N/A

2.4 Reactor pressure vessel

2.4.1 Finding (area for improvement or challenge) from the self-assessment

Not identified.

2.4.1.1 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.

2.5.1.1 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.

3.1.1.1 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 commissioning/construction.

Action 1a:

Within the completion of the units of 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 EBO and EMO. Specific procedures were implemented for individual SSC (e.g. RPV surveillance program, monitoring of the thermal ageing of primary circuit materials, monitoring of loop corrosion processes in primary circuit materials, erosion corrosion monitoring of omponents of secondary circuit, surveillance program for monitoring cables). These specific procedures are continuously reviewed, updated and/or complemented taking into account the supply chain during extended construction period. ÚJD SR performed in 2021 an ispection to confirm the status of works. The ongoing IGALL WG5 project focusing on delayed construction periods, prolonged outages, extended shutdown and post final shutdown is also used during document revision.

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 1b:

In order to achieve progress in identifying degradation mechanisms and managing ageing effects for extended shutdowns, the Licensee reviewed the OAMP as well as the individual ageing management programmes. The revision addressed, inter alia, the following areas – definitions (prolonged outages, extended shutdown, and post-final shutdown), ways of identifying, detecting and monitoring potential degradation mechanisms as well as actions to prevent and minimize the effects of ageing. The output of the ongoing IGALL WG5 project focusing on delayed construction periods, prolonged outages, extended shutdown and post final shutdown is used during document revision. As a consequence UJD SR ´s safety guide on ageing management of NPPS was reviewed to take into account the newest outcomes of IGALL and of TPR on ageing .

The licecensee (SE a.s.) started to review relevant ageing management programs for all NPPs in operation. Extended shut down is understood as when the duration of the shutdown is greatly extended beyond what was originally anticipated (for more than one year owing to unforeseen issues or delays in the return to service) but this does not include regular shutdown for maintenance. Altogether 20 ageing management programs for SSC are subject of this reviev (e.g. main circulation pumps, pressurizer, steam generators, reactor building etc.) Some of the ageing management programs have been already revised/updated (e.g. ageing of cables, diesel generatorś building etc.) whereas others are still in the review process. ÚJD SR performed in 2021 an ispection to confirm the status of works. Based on the status of work it is expected that the revision of relevant ageing

mangement programs to reflect the expectation on ageing management during extended shut down will be completed by end of 2021.

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.

3.2.1.1 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.

3.3.1.1 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.

3.4.1.1 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/commissioning (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.

4.1.1.1 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 and .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.

4.2.1.1 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.

4.3.1.1 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), ÚJD 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.

4.4.1.1 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

(2 x 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 signature; TDR, methods respectively.

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

4.5.1.1 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.

4.6.1.1 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.

4.7.1.1 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. The TDR method was used in 2001–2018 and since 2019 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.

4.8.1.1 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 hosted 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 and action

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 a platform 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.

Action 1a:

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 and EMO NPPs. In the design stage, specific 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 testings 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 1b:

In order to achieve progress in identifying degradation mechanisms and managing ageing effects during extended shutdowns, the Licensee revising the overall AMP as well as the existing ageing management programmes for each SSC. The revision addressing, 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 actions to prevent and minimize the effects of ageing (see chapter 3,.1.1) .

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 Slovakia (no research reactor).

5.1.5.2 Country position and action

Not applicable for 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 and action

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 the 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 and action

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 design requirements 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

For example 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 and action

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 and action

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 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 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. This is considered to be a good practice.

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 and action

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.

No further actions are planned in this area.

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 and action

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.

No further actions are planned in this area.

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.

ENSREG in November 2019 approved the ENSREG 1st Topical Peer Review Action Plan with the objective that each regulator will develop and make public its NAcP by the end of September 2019 for the related nuclear power plants and research reactors. For the other nuclear installations , to report by the end of 2020 (or already in September 2019 on a voluntary bases). In accordance with the Board recommendation and ENSREG decision Slovakia decided to report on AMP of the Interim Spent Fuel Storage located at the Bohunice site and operated by JAVYS a.s. (see ENSREG 1st TOPICAL PEER REVIEW NATIONAL ACTION PLAN OF THE SLOVAK REPUBLIC ON AGEING MANAGEMENT dated 2019)

7 SUMMARY OF THE PLANNED ACTIONS AND THEIR IMPLEMENTATION

Th updated (2021) NAcP of Slovakia provides explanations for the individual findings identified within the TPR on ageing and, where further action is needed explaines the actions taken.

The updated NAcP has been prepared in the following structure :

The introduction describes in general the TPR poces and the preparation of the NAcP. Chapter 2 describes the result of national self-assessments and a description of actions taken to respond to findings identified . During the self assessment three findings have been identified . Status of implementation is summarized in table 1. Chapter 3 contains the country-specific findings of the EU TPR Review Report for Slovakia, and a description of actions taken to respond to ifinding identified (area for improvement) . Chapter 4 provides national practice in meeting the expected levels in the electrical cables area. Chapter 5 presents the national practices of other general findings highlighted in the TPR process. In accordance with the Board recommendation and ENSREG decision Slovakia alreadey reported in 2019 on AMP of the Interim Spent Fuel Storage (Chapter 6). Chapter 7 contains a table summarizing the decided actions and their status.

Table 1

Installation	Area	Finding	Planned action	Deadline	Status
EBO	OAMP (self assessment)	Shortcomings in SSC drawing documentation in relation to the actual condition of the ESW system	Add and update missing drawing documentation	31. 12. 2020	The “as buit” drawings of pipelines are made for the purposes of ageing management and to determine the condition of the Essential Service Water (ESW) pipeline in the main production building (reactor building) , Activities (including drawings) focused first on ESW inlet system at each unit. Later on one ESW outlet system at each unit.

					The wall thickness of the ESW pipeline components from the turbine building to the individual diesel generators in the diesel generator station (DGS)including drawings were performed on components selected based on the results of stress analysis of pipelines at EBO. As for the drawings of ESW pipelines within the DGS, they are under preparation (small bore pipes) because several measurements have been made on these routes, which did not show that the wall thickness had decreased during operation. Closed based on the progress made.
EBO EMO	OAMP (self assessment)	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	End of 2023 (both NPPs)	Investment plan and other organisational measures adopted by the licensee to implement the measure. In progress (it is part of PSR actions)
EBO EMO MO34	OAMP (TPR Review)	During long construction periods or extended shutdown of NPPs, relevant ageing mechanisms are identified and	In order to achieve progress in identifying degradation mechanisms and managing ageing effects for projects of delayed	31. 12. 2021	**a) Long construction period:** Within the completion of the of MO34 , the requirements related to SSCs ageing management were

		appropriate measures are implemented to manage any incipient ageing or other effects	construction and extended shutdowns, the licensee shall revise the OAMP as well as the existing AMPs		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 design and experience from the implementation of the AMP at the EBO and EMO . Specific procedures were implemented for individual SSC (e.g. RPV surveillance program, monitoring of the thermal ageing of primary circuit materials, monitoring of loop corrosion processes in primary circuit materials, etc.). These specific procedures are continuously reviewed and updated and/or complemented taking into account the suplly chain during extended construction period. ÚJD SR performed in 2021 an ispection to confirm the status of works. In progress. **b) Extended shut down** Extended shut down is understood as when the

					duration of the shutdown is greatly extended beyond what was originally anticipated (for more than one year owing to e.g. unforeseen issues or delays in the return to service) but this does not include regular shutdown for maintenance. Altogether 20 ageing management programs (including OAMP) for SSC are subject to the reviev (e.g. main circulation pumps, pressurizer, steam generators main production building etc.) Some of the ageing management programs have been already revised/updated (e.g. ageing of cables, diesel generatorś building etc.) whereas others are still in the review process. ÚJD SR performed in 2021 an ispection to confirm the status of works. Based on the status of work it tis expected that the revision of relevant ageing mangement programs to reflect the expectation on ageing management during extended shut down will be completed by end of 2021.

					In progress