Authority for Nuclear Safety and Radiation Protection

Answers provided by the Netherlands to questions raised in the Topical Peer Review on Ageing Management

Six-yearly Topical Peer Review in compliance with EU's Nuclear Safety Directive 2014/87/EURATOM (NSD)

The Hague, April 2018

Preamble

This document presents the answers of the Netherlands to questions raised in the process of the 'Topical Peer Review on Ageing Management' (TPR-AM) led by the European Nuclear Safety Regulators Group (ENSREG). The present document has been compiled by the Authority for Nuclear Safety and Radiation Protection (ANVS[1]) which constitutes the major part of the competent regulatory body in the Netherlands for nuclear reactors. There was close cooperation with the licensees[2], who provided input on their technical and organisational provisions for ageing management where needed.

Earlier, December 2017, the Netherlands published its National Assessment Report (NAR) for the TPR-AM, as did all countries participating in the TPR-AM. The NAR presents a review of the provisions for ageing management of nuclear reactors, and identifies good practices and areas for improvement. In the period January – April 2018, the participating countries studied each other's NARs, posed questions to others and answered questions received. In May 2018, these will be discussed in a workshop.

Intended audience

This document is mainly targeted at technical experts on ageing management at regulatory bodies and licensees of nuclear reactors of the states that have participated in the ENSREG-led TPR-AM. As agreed the questions and answers have been written in English. Nevertheless, this document will be made available to the general public, serving the objective of transparency.

Background

In 2014, the European Union (EU) Council adopted directive 2014/87/EURATOM: hereby amending the 2009 Nuclear Safety Directive to incorporate lessons learned following the accident at the Fukushima Daiichi nuclear power plant in 2011. Recognising the importance of peer review in delivering continuous improvement to nuclear safety, the revised Nuclear Safety Directive introduced a European system of topical peer reviews, which started in 2017 and will take place every six years thereafter. The purpose is to provide a mechanism for EU Member States to examine topics of strategic importance to nuclear safety, to exchange experience and to identify opportunities to strengthen nuclear safety. The process will also provide for participation, on a voluntary basis, of States neighbouring the EU with nuclear power programmes.

The 30th Meeting of ENSREG identified *ageing management of nuclear power plants* as the topic for the first Topical Peer Review. This selection was informed by a technical assessment from the Western European Nuclear Regulators Association (WENRA) in recognition of the age profile of the European nuclear reactor fleet and the economic and political factors supporting long term operation of European nuclear power plants.

[1] Dutch: 'Autoriteit Nucleaire Veiligheid en Stralingsbescherming', ANVS
[2] EPZ, for the Borssele NPP; NRG for the High Flux Reactor (HFR) in Petten; RID for the Hoger Onderwijs Reactor (HOR) in Delft.

ENSREG decided, in June 2016, to *extend the scope of the exercise by including research reactors with a thermal power larger than 1MW*. For the Netherlands, this meant the research reactors 'High Flux Reactor' (HFR) in Petten and 'Hoger Onderwijsreactor' (HOR) in Delft are included as well.

ENSREG coordinates the topical peer review process, supporting cooperation between Member States. WENRA's Reactor Harmonisation Working Group has supported the process by preparing a technical specification to define the expected scope and content of the NARs.

Objectives of the Topical Peer Review process

- Enable participating countries to review their provisions for ageing management of nuclear reactors, to identify good practices and to identify areas for improvement.
- Undertake a European peer review to share operating experience and identify common issues faced by Member States.
- Provide an open and transparent framework for participating countries to develop appropriate follow-up measures to address areas for improvement.

Process Outline; three phases

- National assessment (January – December 2017) - performed by Member States according to the WENRA technical specification. The NAR presented the results of the assessment conducted in the Netherlands.
    - licensees performed a self-assessment in line with the WENRA technical specification;
    - the assessments were independently reviewed by the ANVS, during preparation of the NAR;
    - the NAR was edited and finalised by the ANVS.
- Peer Review (2018) - including a peer review workshop and publication of a summary report setting out overall findings and ENSREG's proposed follow-up activities.
    - Pre-workshop review of national reports (January – April 2018);
    - Peer Review workshop (May 2018);
    - Publication of Workshop Report (August 2018).
- Follow-Up (2018 – 2023) - definition and implementation of measures to address relevant findings from national assessment and peer review process.
    - Publication of ENSREG Implementation Plan (December 2018);
    - Report status of implementation of follow up actions (December 2023).

Scope

The assessment process examined the application of the ageing management programmes to the following systems structures and components (SSCs):

- Electrical cables;
- Concealed piping;
- Reactor pressure vessels (or equivalent structures);
- Concrete containment structures.

The participation of the research reactors is mainly limited to the overall Ageing Management Programme (AMP) and electrical systems and for one of them the concealed piping.

Questions and answers

Reviewer	Topic	Page number	Question, comment	Country Response
Poland	03. Electrical cables	100	What is licensees experience with using the tool AUREST especially related to analysis and calculations of the end of safe life of cables?	The tool AUREST is very useful to: 1. select the components (including cables) which are during LOCA/HELB situations in a harsh environment; 2. check if every component qualification fulfils the LOCA resistance requirements; 3. calculate the remaining radiological and thermal qualified life of every single component and 4: present the results in a clear overview (page 72, figure 13). The licensees experience with AUREST is positive. AUREST is specifically meant for components, including cables, with a LOCA resistance requirement (harsh environment).
Norway	02. Overall Ageing Management Programme requirements and implementation	43 / 130	"In case of findings not fulfilling the acceptance criteria, at least a condition assessment has to be performed....." -Does these findings cover all SSCs? "…Further operation with or without repair has to be justified in a written document and approved by the regulator." -What is the regulator acceptance criteria for further operation with or	EZP (NPP): This part is related to the ISI-programme. The ISI programme is limited to safety classified mechanical structures and components. ANVS: A. Yes, the condition assessment is applicable to all SSCs not fulfilling the acceptance criteria. B. For further operation of an SSC (repaired or not) its condition has to be assessed. For situations where acceptance criteria are clear these are used. In other cases the acceptance criteria with or without additional requirements will be determined by the

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			without repair?	regulator.
Bulgaria	02. Overall Ageing Management Programme requirements and implementation	chapter 2	Do you use safety performance indicators for overall ageing management program effectiveness assessment? If yes, could you please describe the system and relevant indicators you are using?	EPZ (NPP): So far we don't use safety performance indicators (PIs) for *overall* ageing management program effectiveness assessment. For specific ageing management programs we have specific PIs like number of load cycles, usage factor (fatigue) and RTNDT (RPV embrittlement). RID (HOR): There are no safety performance indicators defined to assess the effectiveness of the overall ageing management program. Effectiveness is evaluated on the functional level of an SSC in Plan-Do-Check-Act cycles, based on the RCM methodology. Safety in such cycles is of course the main driver, but also optimised operational times and cost effectiveness is evaluated. NRG (HFR): NRG does not have an explicit SPI dedicated to AM program effectiveness. The AM is an included parameter of the monitored SPIs.
Bulgaria	02. Overall Ageing Management Programme requirements and implementation	p. 59	The report states that there is an inspection plan for all nuclear installations and ageing management is one of the areas of inspection. Could you please provide more information on what specific inspections on NPP Borssele were fulfilled, their scope, what is	Referring to section 2.6 part a, we have explained that the oversight efforts for the NPP in the past few years and some more years to come, were/will be focussed on the implementation of the LTO programme and related licence conditions. In parallel we have invited IAEA SALTO missions in the period 2009-2014. The reports of the SALTO missions have been published and part of the information can also be found in recent

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			inspected in the framework of inspections, main results and if there is any significant findings from the inspections?	CNS-reports. Furthermore we have stated that currently we are starting to develop a new AM/LTO inpsection programme.
Bulgaria	09. Overall assessment and general conclusions	p. 146	In the report is mentioned that the ANVS will develop a new approach for inspection the AMP, after the completion of the LTO related activities. Is this approach already defined? If yes, could you please present the used concept in more details?	No this is not available yet. Up to 2019 the current inspection programme including additional LTO inspections will be carried out, meanwhile it is in the process of being evaluated. The new approach will be implemented with the new inspection period 2020-2029 (see also answer on Q71).
United Kingdom	07. Concrete containment structures	140	In Section 7.1.4 a description is given regarding the visual inspection of the concrete structures. One of the main subjects of the visual inspection is given as “assessment of the reinforcement”. Please confirm how this is carried out and what the criteria are for taking action?	It is correct that direct visual inspection on the reinforcement is only performed when it is exposed. Inspection of reinforcement that is not exposed rather focuses on damage on the concrete surface, which could result in cracks or exposed reinforcement bars. This is a preliminary inspection, defects are measured, described and upon comparison with acceptance criteria as well as engineering judgment, further investigation is performed. No preventive core drilling is performed by the NPP.

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United Kingdom	07. Concrete containment structures	144	In Section 7.2 the licensee describes a successful application of the ageing management programme in relation to the replacement of the outside cover of the reactor annulus building due to degradation from chloride ingress. It is not clear whether any additional protection was applied to prevent a recurrence of the problem. Please confirm whether a protective coating was applied to the replacement concrete or whether consideration was given to this.	Yes, the cover of the rebar was repaired to its original condition. On top of the repair, an additional layer of concrete was applied and finally the concrete was protected by the application of a protective coating.
United Kingdom	04. Concealed pipework	109	Section 4.1.3.1., table 9 describes the inspection programme for the Bonna-piping at NPP Borsele. Please give an indication of how much of the pipework is inspected during the 3 yearly intervals , how representative these inspections are of the SSC and whether the inspections are speculative or targeted using a risk based approach.	The full length of the Bonna piping is visually examined, using a robotic camera.

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United Kingdom	04. Concealed pipework	110	Section 4.1.3.1, 'Settlement of cooling water lines VF' - Please provide further information about how the level of the lines is physically measured every 5 years and any further operational experience of where this has been used successfully to identify movement of buried pipework.	Settlement of the VF cooling water lines takes place by measurement of the pipe level at dedicated points (e.g., manholes, monitoring wells, connecting points, etc.), using a leveling instrument. Results are compared with dedicated reference points. These measurements are performed by a qualified third party. For connecting points, acceptance criteria are defined, while the measurements of the pipe in the field are mainly used for trending purposes and to complement any findings of the visual inspection of the inside of the pipes. This is only applicable to the NPP's Bonna piping. No further concealed pipework is inspected using this method.
United Kingdom	04. Concealed pipework	115	Flushing would clear contaminants from the pipe internals but would do little to prevent ageing from external types of degradation. Please explain how flushing prevents ageing?	The question refers to the regulator's assessment, where it is stated that ageing prevention of VE is also controlled by regular flushing during periodic testing. Regular flushing would in general prevent ageing by microbiological induced corrosion and by removal of contaminants from inside the pipes. It does not prevent ageing from external types of degradation. However, it is stated in the licencee's text that no relevant ageing mechanisms are applicable to the external surfaces of the backup residual heat removal water cooling system (VE), where this text refers to.

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Slovenia	02. Overall Ageing Management Programme requirements and implementation	58	Regulatory oversight process (Page 58): What kind of requirements did ANVS have regarding Ageing management programs (AMPs) implementation status before the LTO started in 2014. Should all new or modified maintenance programs have been implemented by that time or only systematic phase of AMP should have been established. Did ANVS carry out special inspections or audits dedicated to AMP during licensing procedure for LTO? How is implementation of AMP programs monitored by ANVS during LTO?	The implementation and development of the AMP was a licence requirement with specific deadlines before 2014 for the implementation of most activities, and deadlines up to 2020 for a number of activities - all described in the licence. Up to now NPP Borssele has met the deadlines. The regulatory assessments and inspections during the licensing phase and the implementation of LTO have been described on p.58/59. Also refer to our answers to questions 71 & 72.
Slovenia	07. Concrete containment structures	142	Monitoring, testing, sampling and inspection activities for concrete structures (Page 142): Is sampling of concrete material being performed only for damage assessment, or has been sampling and further testing performed also to assess condition of concrete of safety related buildings during plant normal operating lifetime or is planned for LTO?	The sampling of the concrete as described in this section is part of the further assessment of damage and hidden defects in concrete structures, which is conducted after damage is detected during the normal civil maintenance inspections. This was performed as part of the preparation for LTO, which the plant entered in 2014. The normal civil maintenance programme is considered effective for managing ageing during LTO.

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United Kingdom	04. Concealed pipework	113	Section 4.1.4.1 (and the previous sections) place a lot of emphasis on the suitability of the design to manage any potential degradation mechanisms. As the plants age, are there any concerns that the monitoring/inspection activities will need to change to confirm the ongoing condition of the pipework? Will the need for this be driven by any failures or adverse findings from the current inspection programme?	During preparation for LTO, the NPP conducted an exhaustive review of its ageing management. Any known degradation mechanism for in-scope mechanical, electrical and civil structures and components was evaluated against environmental and operational conditions and existing ageing management activities in cooperation with the Original Equipment Manufacturer (OEM). Additional activities were identified, if considered necessary. There were no concerns about the programmes to confirm ongoing condition of the pipework. This conclusion was substantiated when a large part of the concealed piping was replaced due to the conceptual ageing of the separation concept, which was identified during the PSR.
United Kingdom	07. Concrete containment structures	General	There is no discussion on irradiation effect on the reinforced concrete secondary containment. How are these effects assessed and the long term integrity of the structure validated? Please provide more information on the ageing mechanisms and strategy for irradiation of the concrete containment.	No irradiation effects were considered for ageing of the reactor annulus building, which is outside the primary containment of the NPP and largely outside of the nuclear radiation environment.

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United Kingdom	07. Concrete containment structures	138	Section 7.1.3 Ageing management of indoor concrete building walls, including specific requirements. Concrete walls experience specific deterioration and are visually examined for cracks. Their coating is to remain compliant with their requirements. Please provide more details of the safety claims made on the surface coatings and the constituent properties of the coating material. What are the acceptance limits for the coating?	The section on the ageing management of indoor concrete building walls provides details of specific safety claims for the coating (i.e., fire resistance, impermeability to fluids, chemical resistance, LOCA resistance, ease of decontamination, seismic resistance, radiation protection, internal flood resistance, external flood resistance, gas tightness and other specific requirements) with their acceptance criteria (e.g., Fluid resistant wall coatings must be fluid-tight and are checked to be undamaged; Chemical resistant walls and their coatings are checked regarding any attack and their full integrity. Slight discolouration is acceptable whereas blistering, separation, softening etc. are not acceptable. Signs of saponification are checked in this inspection but not considered as a significant ageing mechanism; LOCA resistant coating has to be intact and without any damages, and the strength of its bond may not have reduced; etc.). Acceptance criteria for the bond strength are according to ASTM D 3359A.

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Switzerland	02. Overall Ageing Management Programme requirements and implementation	23, 54	According to chapter 2.3.1.1 active SSCs are not part of the ageing management process in NPP Borssele. Instead ageing of active SSCs is managed by preventive maintenance and/or surveillance programs. Do you think that this restricted approach is in line with the overall goal of AMP (see chapter 2.5) to develop from the classic approach to an integral SSC oriented ageing management process?	We don't see a restricted approach here. Based on internal and external experiences it became clear that for passive SSCs like vessels, piping etc. a more coordinated approach is necessary to ensure adequate ageing management. Therefore (extra) coordination is introduced with this ageing management process. For active components the ageing management is taken care of by preventive maintenance and surveillance programmes (like periodic testing). These programmes themselves are coordinated too. In case of active components the focus is mostly to (frequently) detect fulfilling of active safety functions while for passive components the focus is on managing potential degradation mechanisms which can compromise the passive safety function integrity. For active components the classic approach is suitable we think while for the passive components more coordination is needed.
Switzerland	03. Electrical cables	19	Textline12: Is there any AMP for active electrical components (motors, valves, sensors, etc.)?	Since the commission of the plant active components are part of the preventive maintenance programme. Measures to maintain active components, analysis of results, improvements in the preventive program, etc., are part of this maintenance process. Specific AMP's are developed for passive components.

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Switzerland	03. Electrical cables	86	Textline7-(step9): Why are the development and effects of water trees not measurable? E.g. with partial discharge measurement?	At the time of the LTOB-AMR there was no reliable measuring method known to detect water trees in medium voltage cables. To derive water trees out of partial discharges seems not to be possible. Partial discharges may exist short before break down. However nowadays Dielectric Spectroscopy measurement is available as a reliable diagnostic method to detect water trees. At the Borssele plant these measurements were conducted on 6000 V cables in 2017 for the first time (see page 93).
Switzerland	04. Concealed pipework	103, 107	According to chapter 4.1.2 (Table 8) the UJ-system consists partly of steel piping. Why are no visual inspections carried out (likewise in the VF-system) although the steel piping may be (potentially) affected by general corrosion (see Table 8)?	The diameter of the steel UJ-lines does not accommodate the application of the robotic camera, used for inspection of VF. Besides this, the trending of the periods of running of the jockey pump in the UJ system to monitor any leakage, and monthly functional testing is considered sufficient for the ageing management of this system.
Czech Republic	03. Electrical cables	73	"…will use of a cable deposit, which is located at the main coolant line in a German PWR NPP." The cables in German deposit are the same as in Borssele?	"… with use of a cable deposit…" A part of the cable types in the cable deposit, available as test specimen, are used in Borssele as well. Qualification data of these cable types are part of AUREST and are used in the qualified life calculations.

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Czech Republic	03. Electrical cables	76	"in this step, the technical data of relevant materials is investigated…", "…for each material a conservative long term temperature and radiation dose is determined"….."Along term temperature of PP material of 100 °C". 3.1.2.1.2 and Fig.17 It seems that the literature data are used. What does it mean Long term, Is it 20 000 hours or 60 years. E.g. 60 years for PP (polypropylene) at 100 °C and 50 kGy seems to me too long. Are these results from experiments on cables or data from literature on material?	In general, for all the insulation materials used, literature and available experience data is used to determine values for temperature (60 years) and cumulative radiological load. This action was fulfilled by a dedicated company, as a step in the LTOB_AMR, and the results are reviewed by both the licensee and the government. Figure 17 is just meant as an example (for PP a temperature of 60 °C is used in the assessment)
Czech Republic	03. Electrical cables	92	"In the calculation model the safe end of life is based on certain maximum allowable degradation. For the insulation material XLPE 80% is chosen, for PVC this is 90 %." (chapter 3.1.3.1) What does it mean? Degradation - decrease of mechanical properties or change of electrical properties? Page 95 says...""in which the	In the calculation model for medium voltage cables, the degradation rate is based on elongation at break values of test specimens out of cable insulation. In this case 80%/90% is a margin related to the density of the model and the insulation material. On page 95 a (simple) bending test of spreader room wiring is described, which gives information about the brittleness of the insulation: over 50% absolute elongation or not.

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			elongation at break of 0.5 is checked by winding around own diameter"". Bending is common method to test if 50 % EtB absolute is reached. How does it correspond with 80 % or 90 % degradation."	
Czech Republic	03. Electrical cables	90	"…The maximum ambient temperature as specified for the applied type of coaxial cable is 85°C. So well within the normal operating environment. In the specification, it is also stated that the MM10/75 cable can withstand at least 7 days of 100°…" (3.1.2.3) Maybe it is OK, but did you tested it? Coaxials are often made of pure PE, which can melt at temperature around 100 °C.	MM10/75 cables are high temperature tested in accordance with BS 2316, clause 6.3.1. No further test are executed by RID.
Bulgaria	05. Reactor Pressure Vessels	p.119	Would you please clarify whether the thermal ageing was considered as well as possible ageing mechanism?	Thermal ageing was in the ageing management review considered as a potential ageing mechanism for the RPV. Particularly based on the specific material constituents (for instance Cu content in the beltline weld and delta-ferrite in the austenitic cladding) in the subcomponents of the RPV, thermal ageing was in the outcome classified as an insignificant ageing

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				mechanism for the RPV of NPP Borssele.
Finland	05. Reactor Pressure Vessels	Chapter 5.3	What are the main safety and operation challenges associated with AMPs. For example, are safe shutdown conditions addressed in a proper way?	Both irradiation embrittlement and fatigue do not give big safety and operation challenges for the RPV. For all the other (corrosion-related) potential ageing mechanisms the challenge is to keep the primary water in the good condition and avoid leakages to avoid borid acid corrosion on the outside of the RPV. In this also safe shutdown conditions are considered.
Czech Republic	03. Electrical cables	70	"As long as the jacket is not damaged, ageing degradation is not considered as highly essential for the function of cable". Where this statement comes from - testing or experience? It cannot be generally stated. I know many examples where jacket was OK, but insulation was totally degraded.	This statement is meant for ageing degradation of the cable jacket alone, not for the insulation of cable cores.

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Czech Republic	03. Electrical cables	79	"….in some cases hot spots in the specific room". (fig. 18) Design temperature is 50 °C and in many positions is more as mentioned in Fig. 18. How the cables are treated in such hot spots? Something is mentioned on page 81 but without details.	See figure 22 for specific temperature areas, all the rooms with hotspots (> 50°C) are known. For use in the assessment measured values were used or, if not available, a margin was added (page 81) on the design value. Cables in these hot spot areas are treated with respect to this environmental temperature.
Czech Republic	03. Electrical cables	84	Figure 24 mentions values of thermal endurance for different materials and should cover 60 years. It seems it comes from literature data. Polymer life time depends on stabilizers, on production, pigments etc. It is not possible to use data for life time assessment. What is criterion of end of life for materials in Fig. 24?	For cables with LOCA requirements a dedicated ongoing qualification program with use of a deposit and end of life criteria based on elongation at break is used. For the rest of the cables the design temperature and design radiological doses of the materials were used as a step in the LTOB-AMR to detect cables which may be in adverse environment. This step was not meant as a safe end of life assessment.
Czech Republic	03. Electrical cables	84, 85	Figures 24 and 25 show thermal endurance and radiation stability of materials. But both stressors act simultaneously.	Statement is correct. If the environmental conditions of a cable includes a high temperature and a strong radiation field this should be taken into account in AM of these cables.

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Slovenia	03. Electrical cables	70	Section 3.1.2 (page 70). Why does not the report consider R&D programmes, objectives, contents, internal and external operating experience?	In chapter 3.1.2.1 (page 70) the ageing assessment of electrical cables for Borssele is described. Applicable operating experience, R&D results, etc, are taken into account in the ageing management (see Figure 3 and 5, page 50).
Slovenia	03. Electrical cables	91	Section 3.1.3 (page 91) Why does not the report discuss third party certification organisations?	Third party certification organizations with respect to cables are indeed relevant for qualification/typetesting of cables. However, this is not part of the report.
Slovenia	03. Electrical cables	76, 88, 93	The Netherlands' NPPs have PVC and SiR cables (page 76, 88, 93). Do the Netherlands' NPPs NPPs intend to replace PVC cables considering the following practices: • IAEA SALTO mission's recommendations that PVC cables should be replaced because of bad material properties, • some countries have already partly or totally replaced PVC cables (e.g. NPPs in Switzerland, Germany, Nederland…) Additionally, the report on page 87 states: "In the result of the cable assessment it was found that 27 cables with a PVC insulation and jacket installed in the areas T1 or T2 may be critical regarding ageing	A number of PVC cables, instrumentation and power cables (6000 V), is replaced to serve as test specimens in an ageing investigation program, carried out by a specialized laboratory (page 93, 96). Based on the results of this program actions will be taken, which may include replacement of cables. The IAEA SALTO mission in Borssele didn't recommend the replacement of PVC cables.

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			degradation for the period of LTO…”.	
Slovenia	03. Electrical cables	101	Are AMPs for cables in Netherlands’ NPPs fully implemented in accordance with national regulation and international standards (IAEA, iGALL…) (page no. 101)?	In Borssele AMP's for cables are implemented in accordance with relevant regulations and standards.
Slovenia	03. Electrical cables	91	Why does not the report (Chapter 3.1.3, page 91) consider R&D programmes, objectives, contents, internal and external operating experience?	In chapter 3.1.2.1 (page 70) the ageing assessment of electrical cables for Borssele is described. Applicable operating experience, R&D results, etc, are taken into account in the ageing management (see Figure 3 and 5, page 50).
Slovenia	03. Electrical cables	96	How do you know in what condition the cables in conduits are? What methods do you use for inspection of cables in conduits? (page no. 96)	Cables in the conduits are visually inspected where the conduits are attainable, which gives a good overview of the state of the cable. If there are doubts on the state of the cable, measurements will be carried out, e.g. insulation resistance.

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Slovenia	03. Electrical cables	102	The report mentions on page 102 that 200 cables are critical. Do you intend to replace these cables with new ones?	A result of the assessment (conservative approach) for cables (page 87) is that a number of cables may be critical for LTO. A program has been started to investigate the ageing behaviour of relevant cable types, the actual temperature/dose rate at cable locations, etc. If necessary cables will be replaced.
Slovenia	03. Electrical cables	34	Why does not the report consider R&D programmes, objectives, contents, internal and external operating experience (page no. 34).	RID (HOR): Page 34 is dealing with the overall ageing management and not with electric cables. The WENRA technical specification does not require to discuss R&D activities in this section. The way R&D programmes, objectives, contents, internal and external operating experience can initiate the procedure for ageing management is described in section 2.4.3 page 53
Slovenia	03. Electrical cables	any	Why does not the report discuss the acceptance criteria frequencies?	EPZ (NPP): What is meant with acceptance criteria frequencies? Examples of criteria for cable inspections & frequencies can be found on pages 94-96. RID (HOR): On p.97 information is provided on monitoring / inspection and an applicable norm. NRG (HFR): The acceptance criteria are based on rules, regulations and guidelines as issued by standards-organisations and involved authorities. For inspection frequencies see table 7 and section 3.1.4.2 which also refers to a test-norm.

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Czech Republic	07. Concrete containment structures	general question on civil stractures	Report doesn´t comment civil structures (building parts) status for research reactors. Could you please provide us some details about the procedure for evaluation of the building objects status? Do objects belong to SSC?	RID (HOR): HOR does not have a concrete containment building. No requirement are requested by the WENRA technical specification on other civil structures. NRG (HFR): The HFR does not have a concrete containment building as the reactor dome is constructed out of steel. One of the action points of the 10-yearly evaluation was containment building inspection. This inspection showed a positive result as the dome did not degrade over 50 years hence there was no need to include an additional AM program. In addition the leak tightness of the dome is tested every year according to the preventive maintenance program.
Belgium	05. Reactor Pressure Vessels	120	Are there dissimilar welds at the RPV inlet and outel nozzles of Borssele and if so, have they been assessed with respect to ageing issues?	No. The Main Coolant Piping is made of ferritic steel. Therefore no dissimilar welds are in the inlet and outlet nozzles of the RPV.
Belgium	04. Concealed pipework	109	A visual (video) inspection programme is performed on a 3-yearly basis. To which extent are the burried piping video inspected? Are they inspected on their full length or are sampling zones selected?	The full length of the Bonna piping is visually examined, using a robotic camera.

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Belgium	02. Overall Ageing Management Programme requirements and implementation	25	COMSY software is used currently used as a specific ageing management database. Is it only used as an ageing database or a specific software to predict/calculate degradations (FAC, SCC, etc.)? Who in the NPP organization is the responsible/owner of this COMSY-database?	COMSY is at NPP Borssele both used as a database for ageing management (incorporating all relevant information for the complete scope of SSC important to safety for all potential degradation mechanisms) and as tool to predict and calculate degradation (reduction of wall thickness) due to ageing mechanisms like flow accelerated corrosion. The owner and responsible department of the COMSY database is the technical support department (KTE).
Belgium	03. Electrical cables	91	For KCB, could you clarify what are the specific monitoring, testing, sampling and inspection activites related to the termination arangements (connections) ?	Cable connections are monitored with thermographic measurements and visual inspections on discoloration. Bolted connections are checked within maintenance activities of active components.
Belgium	03. Electrical cables	91	How was the opportunity to trend the different data gathered during the testing and inspection activities (insulation resistance, pictures taken during inspections...) assessed by KCB ?	If trending of data is helpful in the AM it is used. For example some wiring in cabinet is periodically inspected because leakage of plasticizer was found in the past (page 99). In this case pictures are taken and the status is compared with previous years.

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Belgium	03. Electrical cables	61	Were the cables important for safety of the HFR subject to an environmental qualification programme? If yes, which standard was applied?	Under the assumption that 'environmental' means cable environment conditions, the following is applicable to the HFR. Emergency power supply cables are not subject to variable conditions (as concluded during soil condition inspections) hence a typical qualification is not needed. Furthermore the redundant cable configuration covers safe and continuous operation. Cables in the installation subject to radiation however are replaced based on preventive maintenance programmes. This maintenance was initiated based on a 10-yearly evaluation. Those cables are safety relevant as they are part of the line of defence (reactor shut down).
Belgium	07. Concrete containment structures	135-136	What are the acceptance criteria related to the ageing mechanisms listed?	We refer to the response to the similar question from the UK (record no. 266). Acceptance criteria are provided in the text of the TPR report. Also at the plant, the acceptance criteria are listed in the documentation of the test procedures.
Belgium	07. Concrete containment structures	135-136	Can one example of R&D programmes concerning ageing degradations mechanisms be given?	One example of the application of R&D programmes concerning ageing degradation was the repair and improvement of the outside of the reactor annulus building, which was performed according to the state-of-the-art in protection of rebar in a marine-based environment.

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Belgium	02. Overall Ageing Management Programme requirements and implementation	23	"This means that active SSCs are not part of the ageing management process. Ageing of the active SSC is managed by preventive maintenance and or surveillance". Could you elaborate on how this applies to all sorts of active components? Are they differences in the ageing management of electrical or and mechanical active components?	In general for the electrical SSC a commodity based approach is used while for the mechanical SSC mostly a component based approach is used. The specific approach is depending on the commodity/component. For instance (electrical) batteries are according to the definition active and the ageing management consists of capacity testing of the batteries. For a mechanical valve with an active opening or closing safety function, periodic testing is in the surveillance programme.
Belgium	02. Overall Ageing Management Programme requirements and implementation	19	Concerning the definition of active SSCs, is the definition based on the 10CFR54 or is it a specific Dutch definition?	The definition is based on 10CFR54.
Belgium	02. Overall Ageing Management Programme requirements and implementation	51	Could you elaborate on the process set up for updating periodically all the AMPs and for integrating the evolution of the IGALL database? In particular, which is the maximal period between two updates of a same AMP?	Borssele: In principle every three years the AMPs are updated based on the normal review scheme. However if a lot of changes are applicable AMPs are updated earlier. When AMPs are updated IGALL updates will be included if applicable.

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Belgium	02. Overall Ageing Management Programme requirements and implementation	58	Could you detail the process for deciding which actions have to be completed before the beginning of the LTO period (2013) of Borssele NPP and which ones have to be finalized before 2020? Can you cite examples of actions of both categories?	This was part of the License change process. The LTO assessment including the ageing management review was used as a basis to change the Safety Report. For this change a licence change was required. In 2012 an application for the Licence change was done. In the beginning of 2013 the new licence became in force. The licence was given by the authority and consisted of 11 requirements related to LTO. Some of the requirements had to be performed before going into LTO meaning before January 1th 2014. An example of such a requirement was to deliver an implementation plan for extra In-Service Inspection activities. In the same licence requirement specific inspections were mentioned which have to be performed before January 1th 2018.
Germany	03. Electrical cables	68-69	On p.68-69 the classification of cables at the HOR research reactor based on IAEA guidelines is described. There are no cables in the categories 1-3 at the HOR reactor. For the categories 4-7 a representative conservative example is chosen for each category. Which stressors were part of the assessment in order to decide what constitutes a conservative example? The texts only implies that the dose	RID (HOR): The applied IAEA guide also mentions the stressors to take into account. For a list of the stressors see for example section 3.13 of the IAEA guide. These are considered in the environmental qualification (EQ). It should be realised that the environmental conditions are a lot less harsh in an open pool type 2 MW research reactor, compared to a nuclear power plant for which the IAEA guide is written. Furthermore as there are no cables needed to perform in the categories 1-3 a full EQ (which focuses on DBA conditions) does not necessarily identify cables that are exposed to harsher environment during normal operation or monitoring conditions after an

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			rate was one of them.	DBA. All stressors mentioned in the IAEA guide are considered, but engineering judgement was used to select the conservative example.
Germany	02. Overall Ageing Management Programme requirements and implementation	15	A set of regulatory requirements (NVRs) relevant for ageing management of the Borssele NPP is listed. It is understood that these Dutch requirements originating from IAEA Safety Standards. Can The Netherlands explain how the NVRs applied for Borssele NPP will be updated to take into account latest developments at IAEA (e.g. SSG-25 for PSR, SSG-48 for Ageing Managment and LTO)?	Yes, the Netherlands have the system of NVRs that are based on the IAEA standards. In 2017 it was decided to start a project to update the current NVRs applied to NPP Borssele. The aim is to have them updated in 2020. The update will implement SSG-25 and SSG-48.

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Germany	02. Overall Ageing Management Programme requirements and implementation	50 f., 55	The consequences of the phase-out of nuclear power in Germany for the ageing management of the NPP Borssele are addressed in several places of the report. It is outlined that the NPP Borssele will seek international collaboration and information exchange more outside Germany in the upcoming years. Some examples of the current efforts on this issue are given. Against this background, what are the current most important international activities on ageing management of NPPs from the Dutch point of view and how is the Safety Authority (ANVS) controlling the participation in this activities?	It is true that the gradual loss of German institutions has led to our initiative to establish the KWUREG club. One of the issues that is discussed is of course AM and LTO. Also the remaining KWU plants will work more closely together with AREVA. The most important international activities, according to ANVS, are taking place in the IAEA (IGALL). The Netherlands (mainly the NPP) has participated in that programme from the beginning. For a long time already, the Netherlands has used international experience through IAEA peer reviews (e.g. AMAT in 2003, SALTO 2009, 2012 and 2014). Also the NPP and ANVS participate(d) in such missions as members of review teams. Just recently (2017), also after consultation with the NPP, we have decided to start participation in the OECD/NEA CODAP programme. Participation in OECD/NEA CADAK was also intended, but this programme stopped in 2017. What should also be noticed are the R&D activities carried out in several fora. ANVS has the intention to dedicate more attention to that.

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Germany	02. Overall Ageing Management Programme requirements and implementation	57 ff.	Different activities such as PSR, assessment of the AMP against IAEA Guideline SR 57, and IAEA AMAT and SALTO missions are mentioned. For future inspections of the overall AMP, it is outlined that there is a need to develop a more detailed multi-year inspection programme. How do you see the relationship between the planned multi-year inspection programme and the PSR?	The inspection programme will enable ANVS to determine the strong and weak points of the AMP. This supports the review and assessment of NPP's periodic evaluation reports about the same subject. One of the safety factors of the PSR is ageing management.
Germany	03. Electrical cables	72-73, 97	Cable deposits have the advantage of providing cables from an environment where several stressors (radiation and temperature) are the most severe and allow the conduction of destructive tests on these cables. The Dutch NPP has no cable deposit on its own. Instead it relies on cable deposits in a German nuclear power plant and experiments conducted by the German association VGB. As the last German NPP will cease power operation in 2022 additional measures will be necessary (as concluded by the regulator). However KCB entered power operation almost	Cables which are not covered by the on-going qualification ageing-data of the deposit cables are replaced. Examples are cables of temperature measurements at the main coolant line. Regarding the cable deposit, is the plan is to move the deposit to one of the non-German NPPs in the "VGB working group".

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			15 years earlier than the German plants. How are these additional years of operational loading factored into the qualification process?	
Germany	03. Electrical cables	72-73, 97	In 2014 a cable deposit has been introduced for the HFR research reactor. In principle this is a very commendable effort that is only rarely undertaken for research reactors. However the HFR has been in operation for a considerably longer time than 2014. How has this been accounted for? Were the cables in the deposits "used" cables?	The depot will not represent the condition of cables installed before 2014. The cable depot contains new cables used to determine degradation rate for the future. Other older safety relevant cables have been evaluated during previous 10-EVA sessions.

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Germany	03. Electrical cables	91-92	Lifetime calculations for MV cables are presented on pages 91 and 92. According to the description thermal ageing and ageing due to water trees were considered. What about ageing due to radiation? According to the previous assessment, e.g. figures 26 and 29 PVC medium voltage cables in radiation area R1 are susceptible to ageing.	Radiation is not a stressor for safety and safety relevant MV-cables. The cables in the figures 28 and 29 are all LV cables. MV cables are treated in a specific dedicated program (page 91).
Germany	03. Electrical cables	91-92	The presentation of the results on p. 92 also mentions that 80 % or 90 % of the maximum allowable degradation was chosen as the safe end of life. What was the physical criteria to determine the maximum allowable degradation?	The physical criteria was elongation at break of test specimens out of the insulation.

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Germany	03. Electrical cables	94, 91-96	On p.94 the ageing management activities for low voltage cables are described. Point 3 mentions the testing of mechanical and/or electrical properties when qualitative data of the conditions are necessary. Which properties are measured? Which measuring principles are applied there and how often are those tests usually conducted?	In the laboratory investigation (page 96) elongation at break is the property to determine a substantiated lifetime of the cables. For wiring a simplified bending test is carried out on a yearly basis to have an indication of brittleness of the insulation (page 95). In case of laboratory tests elongation at break is the property to determine a lifetime. Insulation resistance measurements are carried out to monitor the momentary status of LV cables, this in case if visual inspection or other information gives reason for this.
Germany	03. Electrical cables	94, 91-96	In general the description of ageing management activities on the pages 91-96 mention regular visual inspection only for LV cables (not for MV cables) and insulation resistance measurements only for the neufron flux instrumentation and the deep well pump cables. This is unusual as those AM methods are very common. Are there no corresponding activities for the other cable types?	Resistance measurements are carried out for other cables as well. Neutron flux measurement cables are mentioned specifically because they are a specific topic in the technical specification of the TPR. For cable types which may be critical for LTO (outcome of assessment) cables are replaced and used in laboratory investigations to determine a dedicated safe end of life for the existing cables.

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Germany	07. Concrete containment structures	139	It is described (page 139) that one important inspection is the LOCA resistant coating, which is examined visually. Why was it not possible to use more sophisticated methods for this task?	This is possible and the NPP does indeed use further inspection techniques to examine the LOCA resistant coating. The adhesion of coatings to the concrete surface is tested by sampling on an annual basis, by performing a pull-off adhesion test in accordance with ASTM D-4541 pulling a glued test "dolly" from the substrate.
Germany	07. Concrete containment structures		Nothing is indicated in the chapter on 07. Concrete containment structures regarding the inaccessible areas. How are the ageing management programs applied for these areas? What procedures are used to evaluate the ageing phenomena in inaccessible areas?	Inaccessible areas for the reactor annulus building mainly exists in the foundation of the building. For these areas, the quality of the protective tar based coating is inspected and the condition (incl. acidity) of the groundwater is monitored.

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Germany	04. Concealed pipework	109	If no Certified Third Party is involved in the assessment of the buried and underground tanks and pipes, how does ANVS evaluate the inspection programmes for these SSCs and their results?	For the NPP Borssele, ANVS used a 2nd party specialist to assist in the evaluation of the programme and the inspection of these pipes and tanks. As this party is not certified for NPPs by ANVS, her advice is taken into account by ANVS and ANVS carries the ultimate responsibility for the evaluation. Somewhat more background information: For equipment under the Dutch nuclear pressure equipment directive, it is the task of ANVS to review and approve the inspection programmes of the licensees. Usually, ANVS will ask the Certified Third Party and/or its TSO GRS for advice in the review process. The Certified Third Party and the licensees perform their activities based on the inspection programmes approved by ANVS. ANVS is supervising the activities of both, the licensees and the Certified Third Party. ANVS has its own nuclear inspectors with mechanical, material and/or NDO background. ANVS is applying a risk based approach in its supervision activities. For equipment not subject to the Dutch nuclear pressure directive, a graded approach can be applied.
Germany	04. Concealed pipework	110	The determination of any settlement of the water lines appears to be restricted to the VF system. What is the reason not to include the	The reason for not including the VE system in the settlement measuring programme for pipelines is that these pipes largely consist of GRP pipes. These are not prone to settlement in the soil due to their weight. Any settlement is also not as influential on the ageing of

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			VE system in this survey?	the pipe as in the mainly concrete based Bonna piping.
Germany	05. Reactor Pressure Vessels	120	Among the ageing mechanisms to be addressed "thermal ageing" is missing. How is thermal ageing of the RPV addressed in the AMP of KCB ?	Thermal ageing was in the ageing management review considered as a potential ageing mechanism for the RPV. Particularly based on the specific material constituents (for instance Cu content in the beltline weld and delta-ferrite in the austenitic cladding) in the subcomponents of the RPV, thermal ageing was in the outcome classified as an insignificant ageing mechanism for the RPV of NPP Borssele. Based on this in the AMP of the RPV thermal ageing is not incorporated.
Germany	05. Reactor Pressure Vessels	151	The maximum specimen temperature in the surveillance rigs of the HFR remains below 100 °C, while the operating temperature of the vessel is 40 to 66°C. How can it be assured that the surveillance specimens do not deliver unconservative results due to a difference in irradiation temperature?	In the design of the surveillance program (SURP) the representative irradiation conditions have been defined in detail. The temperature is one of these conditions. The design and safety report of the irradiation facility is based on these irradiation conditions. Therefore the irradiated specimens will always be subjected to conditions representative for the vessel.

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RPV expert group	05. Reactor Pressure Vessels	123	5.1.3 According to the information in NAR report (pag. 123), the last specimen for the neutron fluence monitoring will be taken out in 2018 and their assessment will permit to verify if the safety margins for the RPV are still maintained. Considering the long-term operation (LTO), does Borselle NPP have some other additionally monitoring program to surveillance neutron exposure of the vessel materials up to the end of LTO period, i.e an ex-vessel neutron dosimetry program (EVND)?.	In 2010 the neutron fluence was experimentally determined by taking scraping samples from the stainless steel cladding on the inside of the vessel. The results were compared with the theoretical fluence calculations. It could be shown that the results from experimental and theoretical fluence determination matched very well. Based on this it was concluded that the theoretical calculations are reliable to determine with sufficient accuracy the neutron fluence. If needed scraping samples can be taken again in the period from 2018 until 2034 but based on the experimental validation with scraping samples and the high safety margins in the safety assessment of the RPV we don't see the necessity to this.
RPV expert group	05. Reactor Pressure Vessels	128	5.1.4 In page 128 of your NAR is written “One-Time Inspections are periodically performed”. Do you want to say that one-time random inspections are performed in order to verify the effectiveness of water chemistry program?.	Yes

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RPV expert group	05. Reactor Pressure Vessels	130	5.1.4 In NAR page 130 is written "*The ISI-programme at Borssele is based on the ASME XI guidelines …*" Are all ASME XI requirements (scope, frequency, examination, acceptance criteria, etc) fully applied?.	The ISI-programme is based on ASME XI but is not completely fulfilling all requirements. Before every ISI-interval (10-yearly in line with ASME XI) a proposal for the upcoming ISI programme is made and send to the regulator for approval. The accepted programme can have deviations (for instance in scope) from the ASME XI requirements based on both regulatory and licensee proposals (which should be motivated).
Concrete containment PCPV expert group	07. Concrete containment structures	138, 139 and 140	7.1.3 Text of the report: - page 138 *"It is important that there is no cracking of any kind in the concrete"* - page 139 *"Inspection for seismic resistance is executed to confirm the absence of cracks in concrete structures."* - page 140 *"The concrete is checked for absence of cracks"* Question : Since the normal state of concrete is to have at least thin cracks, could the Licensee precise, in terms of crack thickness, the acceptance criterion adopted ? That criterion might depend on the functional requirement of each part of the buildings.	This is correct. The text that is referred to is from the assessment of the condition of the concrete used in the foundation for equipment. The inspections of these foundations do not focus on the typical hairline cracks of well cured concrete, but rather look for evidence that the support is damaged due to undue force that was applied to the concrete foundation and the anchors. Any cracks in that area that could point to undue force that was applied are unacceptable.

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Concrete containment PCPV expert group	07. Concrete containment structures	135	7.1.2 Table 13 Ageing Measures for the Reactor Annulus Building (02) Concerning concrete structures, is the pathology named Delayed ettringite formation (DEF) considered in the AMP ? If not, please explain the reasons that rule out the risk of DEF. If yes, please describe the periodical actions (inspections, sampling, laboratory tests...) carried out in the framework of AMP.	Delayed ettringite formation (DEF) can damage concrete that has experienced a temperature above about 70°C during the curing process. High temperature heat curing history is not considered due to the concrete specifications during building of the NPP.
Concrete containment PCPV expert group	07. Concrete containment structures	136	7.1.2 Table 13 - Foundations Question 1 : Could the Licensee detail the following : "*Inspection of foundations on specific requirements (Seismic)*" ? Question 2 : The NPP foundation is supported by piles. Are they reinforced concrete, or metallic ones ? Could the Licensee present the ageing assessment of the piles ?	Inspection of foundations on specific requirements (Seismic) refer to a specific inspection protocol used at the NPP for this purpose. In this protocol is referred to specific attention for cracks and the connection of anchors. It is also confirmed, during this inspection that the foundation still complies with its design conditions. Piles are made of reinforced concrete and considered part of the foundation of the reactor building, for which the ageing assessment by the OEM formed part of the ageing management review for LTO.
Concrete containment PCPV expert	07. Concrete containment structures	132	Does the report include the concrete structures inside the containment?	Concrete structures inside the containment were not described in the scope of ageing management for the concrete containment structures in the technical

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group				specifications for the National Assessment Reports.
Concrete containment PCPV expert group	02. Overall Ageing Management Programme requirements and implementation	18	On page 5, 6 regarding scope. What method is used to find non-nuclear safety classified civil structure having an consequential risk to nuclear safety?	A combination of (earthquake) classification, plant documentation and plant walkdowns is used to determine which non-nuclear safety classified civil structures should be in scope. Earthquake classification is available. Earthquake class IIB is applicable for civil structures which are themselves not-nuclear safety relevant but which can have an impact on safety relevant SSC in case they collapse.
Concrete containment PCPV expert group	07. Concrete containment structures	132	In accordance with Technical Specification for chapter 7.1.2, can you describe the establishment of acceptance criteria related to ageing mechanisms?	Acceptance criteria are defined in the text for the individual inspection protocols, based on internationally accepted standards, e.g., the ISO 4628 series of standards for the evaluation of degradation of coatings, ASTM D-4541 for coating adhesion and for the inspection and evaluation of concrete constructions, based on the CUR recommendations (Civieltechnisch Centrum Uitvoering Research en Regelgeving - Dutch Center for Civil Engineering Research and Codes)
Concrete containment PCPV expert	07. Concrete containment structures	136	In accordance with Technical Specification for chapter 7.1.3, what are the acceptance criteria for?	Acceptance criteria are provided in the text of the TPR report. Also at the plant, the acceptance criteria are provided verbally in the test procedures.

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group				
Concrete containment PCPV expert group	07. Concrete containment structures	140	From reading chapter 7.1.4 it is our understanding that the visual inspections are the preventive actions for concrete structures that you carry out. Is that correct understood?	Visual inspections are an important part of the inspections to identify ageing. However, in chapter 7.1.4, many examples are provided where other inspection techniques and remedial activities are used in the preventive and remedial actions for concrete structures.
Concealed pipework expert group	04. Concealed pipework	General	Are methods of contactless diagnostics that allow assessment of inaccessible sections used at Dutch NPPs (methods of contactless diagnostics for underground piping: contactless magnetometric diagnostics method; acoustic tomography method. These methods reveal loss of integrity of piping and do not require direct access to piping external surface. Diagnostics is carried out from ground surface above the piping. 100% of piping from all observation groups is inspectable). This information should be added to the Report or corresponding clarifications might be provided as an answer.	Loss of integrity of relevant underground steel pipework is conducted by trending the effort necessary to remain up to pressure in the applicable system, as described in section 4.1.3.1. Buried piping for the system for essential service water, providing cooling for SSCs that are important to safety does not consist of steel piping at the Dutch NPP, but uses the Bonna piping as explained in the report. Visual inspection of these pipes is considered effective.

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Cables expert group	03. Electrical cables	60/61	The lead document on cable management, for the NPP, and for the research reactor HFR. There seems to be a difference in the model, because for the NPP it is mentioned that only the importance for nuclear safety which is a the basis for selecting cables for the AM program. In the Table 3, with cables a for HFR, the Junction Boxes are not mentioned. It is not clear whether there are cables with paper insulation, or other types of insulations, such as oil, or other types.	NPP: In the NPP there are no paper or oil insulated cables. The used insulation materials are listed in Figure 16. HFR: The purpose of table 3 is scoping. The cable types are described by make and type, hence it is possible to find the specification of the insulation. This specification was however not relevant to the table's purpose.
Cables expert group	03. Electrical cables	61	just to confirm all the cables to components that are "safety" or "safety relevant" as in the penultimate para on page 61, are included in the scope of AM. That would include all the cables for the support equipment (to safety related equipment) as well?	Support systems relevant to safety are part of the safety systems. As a result those systems are part of the current AM program. An example is the preventive maintenance of the coax cables of the reactor nuclear channel instruments (which support the safety barrier functions of the reactor). The same applies to the emergency power supply cables (from the emergency generator sets to the reactor). Those cables are equipped with cable resistance monitoring (which indicates cable damage / degradation). The monitoring system itself is subject to a preventive maintenance program.

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Cables expert group	03. Electrical cables	67, table 4	The segregation of the cables at HOR, there is not clear whether there are any medium voltage cables in this program.	RID (HOR): The segregation of cables indicated in the table is the general structure. High voltage cables for instrumentation is an exception to this general table, with dedicated specifications as mentioned in the text just above the table. More information on these medium voltage cables toward ionisation chambers can be found in section 3.1.2.3, for category 5 equipment.
Cables expert group	03. Electrical cables	66	The categorization of cables related to the operating environment (environmental qualifications) is pretty vague. Clarification is needed.	RID (HOR): As mentioned in section 3.1.2.3 the operating environment at the HOR is mild. Environmental classification based on the IAEA guide NP-T-3.6 would always lead to a mild environment. Engineering judgement is used to select the conservative combination of category classification and environmental classification.
Cables expert group	03. Electrical cables	78	Does KCB have any of its own cable deposits, or it relies on German deposits only? Are all the cables used in KBC manufactured in compliance with German standards for NPP cables?	KCB does not have its own cable deposit, but cables used in the plant are within the German deposit. In a VGB working group this deposit is used for a number of plants, among which is Borssele NPP. A large amount of the cables are qualified in accordance with German KTA standards, some newer cables in accordance with IEEE standards.

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Cables expert group	03. Electrical cables	89/98	At HOR, high amps cables between containment and low voltage supply room were replaced. Have the new (replacement) cables the same specifications? Were also the medium voltage cable replaced?	RID (HOR): Cabling between the containment and the low voltage supply room is 380VAC max. According to the WENRA specification 380VAC is defined as the lower boundary for medium voltage cabling. All cabling between HOR containment and low voltage room were replaced. Cables specification is updated to the most recent standards. Main differences include higher isolation and application of halogen free materials.
Cables expert group	03. Electrical cables	90	At HOR, the ionization chambers cables are subject to high doses of radiation and high temperatures. Are those cables still (safely) usable? How did you determine this?	RID (HOR): Dose rates at the position of the boron lined ionisation chambers are actually not high when considering the specification for the applied mineral cables. Nor are the temperatures. Isolation resistance was last tested in 2010, when the signal processing units for these channels were replaced. No degradation was observed. Cables are safely usable due to the fail-safe design.
Cables expert group	03. Electrical cables	93	The NAR indicates that the " knowledge of the model for water treeing is limited". However there are 13 safety and safety related cables that are either considerable beyond or beyond estimated lifetime. What do you intent to do to gain more confidence in the model?	In 2017 6 MV-cables are replaced and used as test specimens to tune the model to the specific cables used in the plant (page 91). So the model is now based on the specific cables used in the plant. Also dielectric spectroscopy measurements are introduced which can detect the presence of water trees.

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Cables expert group	03. Electrical cables	97	For HRF, could you provide more information on test, measuring and demonstration methods that are used for the monitoring of the ageing condition of the cables. What is the frequency of monitoring, testing and inspection activities?	HFR: The cables are tested during operational check out procedures (before reactor restart) at least 10 times a year. Whenever failures occur corrective measures are taken. If needed in-depth evaluation and analyses are performed.
Cables expert group	03. Electrical cables	97	For HOR, are there specific test for the monitoring of the ageing condition of the instrumentation cables beyond the self-monitoring?	RID (HOR): The argumentation in the text shows nearly all cables are designed to be fail safe. No dangerous situation can occur due to failure of a single cable. Therefore no specific test are executed on a periodic base to monitor the ageing of instrumentation cabling.
Cables expert group	03. Electrical cables	100	What is licensee's experience with using the tool AUREST, especially related to the analysis to estimate the end of the life of cables?	The tool AUREST is very useful to: 1. select the components (including cables) which are during LOCA/HELB situations in a harsh environment; 2. check if every component qualification fulfils the LOCA resistance requirements; 3. calculate the remaining radiological and thermal qualified life of every single component and 4: present the results in a clear overview (page 72, figure 13). The licensees experience with AUREST is positive. AUREST is specifically meant for components, including cables, with a LOCA resistance requirement (harsh environment).
Cables expert	03. Electrical	100	Has a systematic thermographic assessment of cables, to identify	Thermographic measurements are not carried out in a

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group	cables		possible hots spots been undertaken at KBC? If yes, were any local hot spots affecting the cables found?	systematic way to identify hotspots for cables.
Cables expert group	03. Electrical cables	100	At HRF the most safety relevant buried cables are the emergency power, from DG . It appears that for those cables no comprehensive inspection program to determine degradation exist.	HFR: The redundant cable configuration covers safe and continuous operation. In addition the cable resistance of both cables is monitored continuously. In case any degradation is measured corrective actions will be taken.
Cables expert group	03. Electrical cables	102	At HOR, the majority of cables (safety significant) were replaced 35 years ago, when the control room was moved outside the reactor building. Given the long time interval are these cables are still in good condition?	RID (HOR): It is good to realise that the environmental conditions of the cables at the HOR can be considered to be mild. Furthermore no category 1-3 cables (according IAEA NP-T-3.6) exist at the HOR. Visual inspection and bending of the cables shows no degradation of the insulation. Safety relevant cabling was last tested on isolation resistance in 2010. No degradation was measured. Together with the fact that no dangerous situation can occur due to failure of a single cable, the cables are fit for purpose.
General AMP expert group	02. Overall Ageing Management Programme requirements and	4	it is mentioned also that the Aging management program of HFR is still in progress, and the requirements (*input*) of the regulatory body are not specified, mentioning that the regulatory body is expecting the licensee to provide the next steps and	At 29-12-2017 the ANVS received the Asset Management development plan which includes ageing management. In the ANVS official reply it is stated that this planning shall be followed.

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	implementation		information on the milestones.	
General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	36	In the presentation of the aging assessment of HFR (High flux reactor), the presentation (specific information) is not quite specific, being more a set of requirements from textbooks, or guides. The presentation should concentrate more on what was really implemented in the reactor. The theoretical part from the textbooks should be skipped, because these are common for each AM program. The report should present fact like the number of repair activities, corrective / preventive maintenance actions, frequency of tests, repairs, equipment in the scope of the program, etc.	HFR: The HFR has many sources of data available which could be used for an AM program. The complete AM program system however needs further development as described in the report. Yet particular monitoring and corrective action programs exist like the primary cooling water pump inspection and the monitoring program.

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General AMP expert group	02. Overall Ageing Management Programme requirements and implementation		Regarding chapter 02 the Netherlans report is following the technical specifications and is well structured with sufficient information to cover the subchapters of Chapter 2. It should be noted that is has incorporated the information about the research reactors in the subchapters accordingly.	Thank you.
General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	42 - 47	From the text is not very clear if there are any provisions for identifying unexpected degradation set in place for the NPP and the research reactors. Could you provide more information about that?	NPP: At NPP Borssele an ageing experience feedback procedure is in place in which internal and external ageing events are assessed and if needed the existing ageing management is modified. This procedure is described on page 17 and 18 of the NAR. If unexpected degradation occurs this will be assessed according to this procedure. HFR: During the 10-EVA (10 yearly PSRs) the existing programs are assessed addressing all applicable degradation mechanisms. RID (HOR): By identifying the individual SSCs of the HOR and evaluating the possible ageing degradation mechanisms, unexpected degradation is eliminated as much as possible. If something is truly unexpected it is hard to provide provisions. Only mitigating actions can then be prepared

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General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	33	Figure 7 is not referred in text. QA coordinator is (correctly) coordinator.	RID: ok, to be corrected in the text
General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	34	In case of AM of HOR: RCM is placed into centre of AM. RCM as maintenance in general ensures functional integrity of components (it is correct in text, see "RCM focuses on maintaining functionality"). AM, however deals primarily with structural integrity of passive components, and it is not included into RCM, see flowchart of Figure 8.	RID (HOR): RCM is recommended by the NUREG to be used in ageing management. RCM is only guiding a way to do AM. The statement "run to fail" in figure 8 can be replaced by "used till failure" to include passive components in the general strategy to set up the AM.
General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	40	Surveillance program: please write unstable crack growth instead of fracture growth, and crack length instead of fracture length (page 41).	HFR: This chapter describes failure analysis, but description in the report could have been more specific.

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General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	40	ASME BPVC XI is dealing with ISI of NPP components. HFR is a research reactor.	HFR: As there are no guidelines for aluminium systems the ASME BPVC XI is used as a guideline.
General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	43	What is the origin of the three extra sets of surveillance specimens? Please explain.	The extra sets are made of original RPV material which is still available in the storage of the plant. More information can be found on page 122.
General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	43	NDT system qualification: is it done according to ASME Section XI or ENIQ methodology? Please clarify.	In principle qualification according to ENIQ is done for NDT. The exact qualification procedures have to be agreed upon by the independent certified party.
General AMP expert group	02. Overall Ageing Management Programme requirements	48	Why both mechanical and chemical cleaning was necessary to clean steam generator tubing?	By mechanical cleaning alone the sludge on the tube sheet could not be removed completely. With the combination of mechanical and chemical cleaning a large part of the sludge could be removed lowering the

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	and implementation			risk of local corrosion as much as possible.
General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	50	First para: instead of conformities please write non-conformities.	yes this should be non-conformities.
General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	50	Is environmental qualification a TLAA? I do not think it is.	EPZ (NPP): Environmentally qualification is formally not a TLAA according to the TLAA definition but because of the time related aspects it was treated as one.
General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	57	Control valve corrosion in HOR: please describe the type of corrosion for better understanding.	RID (HOR): The coating specification of the valve housing did not include requirements on the coating underneath the seat rubber. Due to intrusion of process water behind the seat, corrosion was formed on an uncoated strip on the casted iron valve housing. Corrosion was formed due to oxygen in the process water which intruded behind the valve seating. More information on this specific accident can be found in

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				the IAEA IRSRR database, with IRSRR number 206.
General AMP expert group	02. Overall Ageing Management Programme requirements and implementation	59	Embedding AMP in organization: instead of "maintenance part of organization" it is advised to put it in enegineering support part, as usual.	According to the ANVS there is no 'one size fits all' solution for all types or sizes of reactors and it does not matter how things are organized as long as the licensee can demonstrate to the satisfaction of the ANVS that the AMP is an effective system.

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EC	02. Overall Ageing Management Programme requirements and implementation	18	2.3.1: Scope: it seems that only passive components are included in the scope. It is true that these components have a self revealing nature of ageing effects. However, certain parameters (flow, pressure, vibrations,…) could indicate ageing in other (passive) parts of the system. How is this taken into account? How is the complete health of a system assessed (system health reports)? Moreover, certain ageing mechanisms do not discriminate between active and passive (e.g.: effects of water chemistry on valves).	Only passive components were part of the Ageing Management Review and in principle the implemented ageing management process is taken into account only passive structures and components. This does not mean that active components have not been reviewed or no ageing management is done. In the LTO assessment the active components also have been assessed. A verification was done to prove that all safety functions of active components are managed in a preventive maintenance or a surveillance programme. The ageing management of the active components is relied for upon the preventive maintenance and surveillance programme while for the passive SSC on top of that an integration process is implemented combining all the specific activities. It is not clear what is meant with self revealing nature of ageing effects for passive components. This seems more applicable for active components. In Borssele also system health reports are made for critical systems. In this all the components are involved. The ageing management process delivers input for the system health reports (for the passive parts).

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EC	02. Overall Ageing Management Programme requirements and implementation	24	2.3.2.: Ageing assessment: How are transients (e.g.: SCRAM, thermal shocks, etc.…) included in the workflows fig 4 p24)	As part of the fatigue Ageing Management Programme a load catalogue is available in which all transients are specified. Every year all the relevant transients are counted and analysed and brought together in a yearly fatigue monitoring report. This report forms the basis of extra fatigue management measures if needed.
EC	02. Overall Ageing Management Programme requirements and implementation	26	2.3.1.: Scope: point e of the WENRA T.S. has not been discussed. Do indicators exist to monitor the process?	Specific indicators exist like cumulative usage factors for fatigue, residual lifetime for part of the electrical equipment and RTNDT for the RPV. On the overall level of the process performance indicators still have to be developed.
EC	02. Overall Ageing Management Programme requirements and implementation	30	2.3.1: Scope: it seems that the SSC for the scope of HFR have been determined, but that actual completion of the AMP might take some time. Have any deadlines/milestones been identified?	The mile stone plan exists and has been submitted by the LH to the ANVS for evaluation.
EC	02. Overall Ageing Management Programme requirements	32	2.3.1.: Scope of the HOR: are any indicators used to assess the effectiveness of the maintenance/ageing process. If so: do these indicators justify a revision	RID (HOR): The newly developed ageing management program will be evaluated in the next Periodic Safety Review round. Changes in ageing management on SSCs are evaluated in their own Plan-Do-Check-Act cycles,

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	and implementation		frequency of 10year-1?	which do not have a set period of 10 year.
EC	02. Overall Ageing Management Programme requirements and implementation	36	2.3.2.: There are no R&D needs listed in this paragraph. Does that mean that there are no such needs?	EPZ: R&D on the use of Film Forming Amines is of interest for Borssele. EPZ is following conferences on this. HFR: There were needs for R&D in the past, like the corrosion of aluminium. Such R&D-programs have been executed. In addition the SURP program is a continuing R&D-type program. RID (HOR) does not foresee any R&D needs for our ageing management program. In case of missing expertise this knowledge is consulted/hired or discussed in the Research Reactor community, as described in section 2.4.3 of the NAR.
EC	02. Overall Ageing Management Programme requirements and implementation	43	2.3.3: leakage management program including walk downs is in place. Please could you indicate who performs those walk downs (field operator, maintenance engineer, design engineer, operations engineer?) and with what frequency.	Walkdowns are performed by the field operators as part of their procedures but also leakage rounds are done by the engineering department at the end of the outage. In this rounds also the independent third party is participating to report to the nuclear regulator.

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EC	03. Electrical cables	94	In relation to AM of LV cables in Borssele: "3. Testing of mechanical/electrical properties when…necessary". What is the criterion for decision? What tests are performed? What are the acceptance criteria for those tests?	Criteria for cable inspections are e.g. "discoloration, cracking due to embrittlement, melting and swelling of wire and conductor insulation and cable jacket". In an engineering judgement it will be decided if measures are taken necessary. But also other in- and external operating experiences can be the reason for measures. Examples of measures are the laboratory investigations on LV and MV cables mentioned in the NAR to **determine** a safe end of life based on elongation at break. Insulation resistance measurements may be carried out if there are doubts about the state of the cable as result of visual inspections.
EC	03. Electrical cables	97	What is the frequency for taking test samples of HFR cable depot?	HFR: This is not defined yet, as the cables have been subjected to radiation for 3 years only, hence this is not a relevant matter at this moment.
EC	03. Electrical cables	Generic 60-102	Comment: The NAR should list the groups of electrical cables included within the AM. Such list cannot be found for the Borssele NPP.	The groups for Borssele NPP are described on page 61.

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EC	05. Reactor Pressure Vessels	Chapter 5.1.3, page 126	In the page 126 it is stated: "At NPP Borssele Corrosion Fatigue was taken into account in the revalidation of the fatigue analyses for 60 years of operations. To do this a (at that time) draft German KTA guideline 3201.2 (Teil 2)56 was followed." Question: The final version on KTA 3201.2 was issued in November 2013. Has been it verified that the fatigue analysis remains valid?	The draft KTA guideline 3201.2 was used to have a criterion for screening on environmental fatigue. In the draft version a CUF of 0.2 was applicable for austenitic steel. In the current version of this KTA this CUF was changed into 0.4. For Borssele this means that the used screening criterion for austenitic steel results in more fatigue locations to be assessed on environmental fatigue. This has no influence on the validity of the fatigue analyses.
EC	07. Concrete containment structures	133	Please provide a legend for Figure 33 identifying the numbered items in the diagram (some are obvious, but items 5 and 6 are not)	Figure 33 was included as an graphical representation of the written description of the Reactor Annulus Building and the numbered items were not considered important for clarifying this representation. However, the legend for the numbered items is as follows: 1 - Reactor Pressure Vessel 2 - Steam Generator 3 - Safety injection buffer tanks 4 - Polar crane 5 - Access ladder 6 - Installation area 7 - Steel containment sphere 8 - Concrete dome section of concrete reactor annulus building 9 - Fuel loading machine

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EC	07. Concrete containment structures	144	Crazing, delamination and flaking of the applied coating indicated that in the event of a LOCA, the coating would not have resisted the heat impact. Consequently, it was beyond the end of its life. Has it been estimated how long the coating had been in a condition that it would not perform as designed? Will future inspections be able to detect degradation and anticipate the end of life before the next scheduled inspection?	The inspection was performed due to the results of the VGB-Arbeitsgruppe"Gesicherte Sumpfansaugung" in 2000. A root cause analysis at that time identified inappropriate use of nitrogen freezing of pipelines in the area to be the cause of the premature ageing of the coating. Applicable areas were covered by stainless steel sheeting at that stage, to prevent that any damaged concrete as a result of a LOCA would become dislodged. From that point on, annual visual inspections on the remaining coatings have been performed as described in the TPR report, as well as annual pull-off adhesion tests, which is currently considered sufficient for early anticipation of degradation.
EC	07. Concrete containment structures	135 - 140 (Table 13) and section 7.1.3	No, or very little, information is provided on the acceptance criteria for the different degradation mechanisms and inspections, as requested in the WENRA Technical Specification. Please could you provide some further details.	Acceptance criteria are defined in the text for the individual inspection protocols, based on accepted standards, e.g., the ISO 4628 series of standards for the evaluation of degradation of coatings, ASTM D-4541 for coating adhesion and for the inspection and evaluation of concrete constructions, based on the CUR recommendations (Civieltechnisch Centrum Uitvoering Research en Regelgeving - Dutch Center for Civil Engineering Research and Codes). Acceptance criteria are described in the text of the TPR report. Also at the plant, the acceptance criteria are provided verbally in the test procedures.

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EC	07. Concrete containment structures	135, 136 (Table 13)	It is not clear why 'inspection of foundations on specific requirements (Seismic)' and ' Settlement survey for buildings' are linked with 'Change in material properties' and the three ageing mechanisms associated with it (leaching, carbonation and elevated temperature) in Table 13.	This is correct. The programmes 'inspection of foundations on specific requirements (Seismic)' and ' Settlement survey for buildings' do not belong in this table.
EC	07. Concrete containment structures	137, Table 14	It is not clear why concrete outdoor walls do not have the same requirements as the roof, e.g. seismic requirements and external impact are not listed as relevant.	This is correct. The programmes shown in table 14 are actually examples of existing structures, which in this case have differing requirements. The inspection protocols of the plant do in fact have dedicated sections for all special requirements for foundations, floors, walls, outer walls, ceilings and roofs, i.e., for seismic, security, radiation protection and decontamination requirements, air/gas/fluid containment, explosion, fire protection, LOCA, flooding, airplane crash, chemistry, ionizing and special environmental conditions.

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EC	07. Concrete containment structures	140-141	Can you provide a bit more information regarding the acceptance criteria for cracks and other damages identified during visual inspection and which circumstances would lead to performing a further assessment with the chipping hammer.	Acceptance criteria for cracks concern the location of the cracks, the crack pattern, including orientation, form and depth, if the crack is in the vicinity of rebar, if evidence of rust (colouration) is present, if water is seeping or bleeding from the crack. The crack width is measured with the aid of a crack measurement magnifying glass or crack dedicating map and the crack length is taken into account. Edges are evaluated for erosion and in case of parallel cracks, the distance between cracks is recorded. If it would be decided that the cracks will still be acceptable until the next inspection, photographic evidence is recorded. Similar considerations are made for other damage mechanisms, evaluating the results of the visual inspection.
EC	07. Concrete containment structures	140-141	Is any testing performed with the aim of detecting the potential for reinforcement bar corrosion (e.g. tests for carbonation of the concrete) before any visible effects of deterioration are found in the visual inspections or are these tests only performed after finding defects at the surface of the concrete?	No preventive core drilling is performed to detect potential corrosion issues. Additional techniques will only be utilized as a result of visual indications.

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EC	07. Concrete containment structures	general	Are there parts of the containment structures included in the AMPs for which potential degradation mechanisms have been identified but which are not accessible for inspection? How is the demonstration made for these structures that no degradation has occurred that can affect their ability to perform their required functions?	The scope of the concrete containment structures for this TPR consists of the Reactor Annulus Building, for which there are no areas that are not accessible for inspection of potential degradation mechanisms, with the exception of the foundation below ground level (including piles) as described above.

This is a publication of

Authority for Nuclear Safety and Radiation Protection (ANVS)

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April 2018