Western European
WENRA RHWG
Nuclear Regulators Association

Report

Topical Peer Review 2017 Ageing Management Technical Specification for the National Assessment Reports

RHWG Report to WENRA
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00.1 Introduction

The European Union's Nuclear Safety Directive 2014/87/EURATOM (NSD) requires the member states to undertake topical peer reviews (TPR) every 6 years with the first starting in 2017. For each review the directive requires the following:

(a) a national assessment is performed, based on a specific topic related to nuclear safety of the relevant nuclear installations on their territory;
(b) all other Member States, and the Commission as observer, are invited to peer review the national assessment referred to in point (a);
(c) appropriate follow-up measures are taken of relevant findings resulting from the peer review process;
(d) relevant reports are published on the above mentioned process and its main outcome when results are available.

The member states, acting through the European Nuclear Safety Regulators Group (ENSREG), have decided that the topic for the first topical peer review is ageing management.

The **objectives of the Topical Peer Review process**, as agreed by ENSREG, are to:

- Enable participating countries to review their provisions for ageing management of nuclear power plants, 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.

Whilst these objectives were initially established for nuclear power plants (NPPs) specifically, the scope of the TPR has been extended to include research reactors and these objectives apply equally to those.

The first stage of the peer review process is the production of a **national assessment report** for each country participating in the topical peer review, as required under item (a) above. **This technical specification defines the structure and contents of the national assessment reports to facilitate an effective peer review.** The other stages of the TPR are specified elsewhere (i.e. the Terms of Reference for TPR process).

The **objectives of the national assessment report (NAR)** are to:

- describe the overall ageing management programme including:
  - Programmatic aspects;
  - Implementation of overall ageing management programme;
  - Experience of the application of ageing management;
- assess the outcomes to identify main strengths and weaknesses;
- identify actions to address any significant areas of improvement;
- produce a report in sufficient detail to a set format to allow a meaningful peer review.

A list of abbreviations used within this specification is included in Annex 2 to this specification.

00.2 Topic for the review – ageing management

The Western Nuclear Regulators Association (WENRA) Safety Reference Levels for Existing Reactors (RL) Issue I describes the WENRA countries expectations for ageing management for NPPs (www.wenra.org).

Based on RL I1.1, within this technical specification**, ageing** is considered as a process by which the physical characteristics of a structure, system or component (SSC) change with time (ageing) or use (wear-out). A related topic in determining the safety of nuclear installations is obsolescence of SSCs, i.e. their becoming out of date in comparison with current knowledge, standards and technology. Obsolescence is viewed as a different issue that is not related to the plant items within the scope of the topical peer review. Obsolescence is therefore not included within the specification.

Ageing management is understood as the engineering, operations and maintenance actions undertaken by a licensee to prevent or to control within acceptable limits ageing degradation of SSCs of its installation. With regard to safety it ensures the availability of required safety functions throughout the service life of the plant, with account taken of changes that occur with time and use and by considering all service conditions.

Ageing management is an important element for the safety of long term operation, but this is only one application. The TPR focuses on the general application of ageing management to the plants under review, irrespective of the stage of their lifecycle.

Ageing management of nuclear installations is applied to many SSCs. Those which are managed for economic purposes are outside the scope of the topical peer review. **The NAR will focus on SSCs important to nuclear safety**, which includes:

- SSCs important to safety that are necessary to fulfil the fundamental safety functions;
- Other SSCs whose failure may prevent SSCs important to safety from fulfilling their intended functions.

Within this specification, the use of the term SSC should be taken to mean an SSC important to safety as defined above.

A key RL within issue I is RL I1.1, which requires each operating organisation to have an **ageing management programme (AMP)**. This RL further describes the AMP as:

> "*an integrated approach to identifying, analysing, monitoring and taking corrective actions and document the ageing degradation of structures, systems and components*"

Thus, the objective of AMPs with regard to safety is to ensure the prevention, the timely detection and mitigation of any age related degradation that could impact the safety functions of SSCs.

The term AMP can be applied in a number of ways. It can be applied at the level of an individual SSC to describe the approach to ageing management for that particular SSC. It can also be used to describe the general or umbrella programme, which covers all of the SSCs at a plant or a number of plants. Within this specification, the latter is termed the "overall AMP".

The assessment of ageing management will focus on assessing the AMPs, covering:

- **Overall AMP;**
- **SSC specific AMPs.**

00.3 Scope of nuclear installations to be covered in the national assessment report

The national assessment report will cover the following types of nuclear installations:

- Nuclear power plants;
- Research reactors with a power equal to 1 MW_{th} or more;

Research reactors with a power below 1 MW_{th} may also be included on a voluntary basis.

The national assessment report will cover all nuclear installations that will be:

- Operating on 31st December 2017; or
- Under construction on 31st December 2016.

Those installations which are permanently shutdown and have a regulatory or competent authority obligation to not operate or generate electricity beyond 31 December 2017 are excluded from the national assessment report.

Nuclear installations under construction are those for which permission for construction has been granted. For these it is expected that ageing phenomena will have been considered in design assumptions. Thus, some detailed parts of this specification would generally not be applicable at the current stage of their lifetime.

For NPPs, utilities within Europe operate the following designs for operating reactors:

- PWR;
- VVER (which is considered to be a PWR for the purposes of this technical specification);
- BWR;
- CANDU;
- AGR.

Some of these designs have more than one type and these are all within the scope of the TPR.

00.4 Systems, structures and components to be addressed in the national assessment report

The member states acting through ENSREG have decided that examples for describing implementation of the overall ageing management program will address the following SSCs:

- Electrical cables;
- Concealed pipework;
- Reactor pressure vessels;
- Concrete containment structures.

These SSCs need some interpretation in the context of some of the nuclear power plants covered by the TPR. These are:

- For CANDU reactors the pressure vessel consists of a calandria and pressure tubes;
- AGR, instead of steel reactor pressure vessels and containment concrete structures, have pre-stressed concrete pressure vessels.

As a result the SSCs used as examples for ageing management in the NAR are as follows:

- Electrical cables;
- Concealed pipework;
- Reactor pressure vessels;
- Calandria/pressure tubes (CANDU);
- Concrete containment structures;
- Pre-stressed concrete pressure vessels (AGR).

The objective of SSCs selected is to provide examples of how implementation of the overall ageing management programme performs in practice. The selected SSCs are considered as giving a suitably broad basis to assess implementation of overall ageing management programme for the purpose of this peer review.

00.5 Format and content of the national assessment report (NAR)

For nuclear power plants, WENRA has developed RLs for ageing management, mainly within Issue I of the RL document[1], which reflect expected practices to be implemented in the WENRA countries. The relevant RLs provide a framework for the national assessment report.

The NAR will be produced by the nuclear regulator to the format and content described in this specification with significant input from the licensees.

Each country will make its NAR available in English.

Attention should be given to types and detail of the information in order not to compromise Nuclear Security issues. The report will be published in the public domain.

The NAR shall not contain specific technical information, which have to be classified as export controlled "Technology" according to Council Regulation for Dual-Use-Goods (EU 428/2009), i.e. manufacturing, developing and use of controlled technology. The processes for licencing of such specific technical information would not be commensurate with the scope of the TPR.

To ensure the national assessment reports can be used for an effective peer review process, the titles and numbering of the main chapters of the national assessment reports will be as follows:

1 General information

2 Overall ageing management programme requirements and their implementation

3 Electrical cables

4 Concealed pipework

5 Reactor pressure vessels

6 Calandria/pressure tubes (CANDU)

7 Concrete containment structures

8 Pre-stressed concrete pressure vessels (AGR)

9 Overall assessment and general conclusions

10 References

A detailed contents list of the NAR is presented in Annex 1. Each NAR should follow this template.

Annexes can be used to present detailed information if necessary. In addition a preamble explaining the basis and goal of the NAR and/or an executive summary may be included.

[1] http://www.wenra.org/media/filer_public/2014/09/19/wenra_safety_reference_level_for_existing_reactors_september_2014.pdf

Chapters 01 to 09 of this technical specification describe the content of the national assessment report and the sections within each chapter, with the numbering consistent with the list above.

The main technical content of the NAR is in chapters 02 to 08 and the purposes of these chapters are as follows:

- **Chapter 02 should describe the processes used to produce the overall AMP (see §00.2), implement it and act on the results;**
- **Chapters 03 to 08 should describe the application of ageing management to a series of specific example SSCs and hence the content of the related AMPs at nuclear installations.**

Chapters 02 to 08 identify the key information that is expected to be presented in the report. The range of plants and SSCs in the member states means that the content of these chapters may not be exhaustive. If other relevant information concerning the topics is needed, it should be incorporated into the NAR.

If a chapter of the report is not applicable to a particular country or to nuclear installations under scrutiny in the NAR, the NAR will still include the chapter, but just include the statement "Not applicable" and a very short explanation.

Each member state will have to report on the whole scope of the relevant installations in its country. This may include a variety of reactor designs, different generations of designs and plants operated by different licensees. There may be a need to use a further level of subsections. These should be structured as follows:

- Matters common to all installations
- Commonalities to all NPPs
    - Further sub-sections grouping plants or licensees at the discretion of the member state, for example:
        - Light water reactors; and/or
        - PWRs, BWRs; and/or
        - Licensees;
- Commonalities to all research reactors
    - Further sub-sections grouping plants or licensees at the discretion of the member state

The **level of detail** within the NAR will be:

- consistent with the stage of the lifecycle. In particular for those under construction it will be focused on integration of ageing management into the design;
- related to the safety significance.

01
General information

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01.1 Nuclear installations identification

All nuclear power plants and research reactors that are operating or under construction as defined within section 00.3 should be listed. The key parameters for each of them should be described with, for research reactors, a clear statement concerning their inclusion or non-inclusion within the scope of the NAR. If necessary, this information can be presented in an annex to the report. The key parameters should include:

- Name;
- Licensee;
- Type of reactor;
- Power output;
- Year of first operation;
- Scheduled shutdown date (if any).

Where research reactors below the limit for mandatory inclusion of 1 MW_{th} are, on a voluntary basis, addressed in the NAR similar information should be provided for each installation.

Research reactors below the limit for mandatory inclusion, either in operation or in construction, which are not addressed in the NAR should be listed, with their power output.

01.2 Process to develop the national assessment report

The process used to develop the national assessment report should be described including the roles of:

- The regulator;
- Licensees;
- Other stakeholders.

02
Overall Ageing Management Programme requirements and implementation

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It is expected that this chapter of the national assessment report will be 20 to 80 pages in length.

For guidance on the structure within sections §2.2 to §2.4 see §00.5

02.1 National regulatory framework

The NAR should include a brief overview of the regulatory system relevant to ageing management to allow understanding of requirements and guidance and their implementation related to the development and implementation of the overall ageing management programme. It should identify key regulatory documents and guidance, as well as technical standards used domestically.

02.2 International standards

The national assessment report should describe how international standards are used in developing the overall AMP including:

- relevant WENRA safety reference levels;
- IAEA safety standards and guidance, including the proven practices described in the IAEA's International Generic Ageing Lessons Learned (IGALL) programme.

This should focus on the process for developing the overall AMP rather than AMPs for specific SSCs. The latter are addressed in the examples in chapters 03 to 08. For example, this section should not describe specific standards for managing ageing of reactor pressure vessels.

02.3 Description of the overall ageing management programme

02.3.1 Scope of the overall AMP

WENRA I1.1 *The operating organisation shall have an Ageing Management Programme (AMP) to identify all ageing mechanisms relevant to structures, systems and components (SSCs) important to safety, determine their possible consequences, and determine necessary activities in order to maintain the operability and reliability of these SSCs.*

Different licensees may have developed overall AMPs as described in section 00.2 in different ways. For example they may produce them for a whole fleet of reactors and/or they may produce them for individual plants. Within this section it is expected that the NAR will describe all relevant overall AMPs.

The national assessment report should present in this section the scope of the overall AMP by describing:

a) Assignment of responsibilities within the licensee's organisation to ensure an overall AMP is developed and implemented;
b) Methods used for identifying SSCs within the scope of overall AMP;
c) Grouping methods of SSCs in the screening process;
d) Methodology and requirements for evaluation of the existing maintenance practices and developing of ageing programmes appropriate for the identified significant ageing mechanism;
e) Quality assurance of the overall AMP in particular:
    - Collection and storage of data and trending of information on maintenance history and operational data;
    - Indicators used to assess the effectiveness of the process.

The implementation of the overall AMP is addressed in the following subsections.

02.3.2 Ageing assessment

WENRA I2.1 *The licensee shall assess structures, systems and components important to safety taking into account relevant ageing and wear-out mechanisms and potential age related degradations in order to ensure the capability of the plant to perform the necessary safety functions throughout its planned life, under design basis conditions.*

The national assessment report should address the following:

a) How key standards and guidance, as well as key design, manufacturing and operations documents are used to prepare the overall ageing management programme;
b) Key elements used in plant programmes to assess ageing;
c) Processes/procedures for the identification of ageing mechanisms and their possible consequences;
d) Establishment of acceptance criteria for ageing;
e) Use of R&D programmes;
f) Use of internal and external operating experience.

02.3.3 Monitoring, testing, sampling and inspection activities

WENRA I2.2 *The licensee shall provide monitoring, testing, sampling and inspection activities to assess ageing effects to identify unexpected behaviour or degradation during service.*

The NAR should describe the derivation of the licensees' programmes for monitoring, testing, sampling and inspection activities including the following:

a) Programmes for monitoring condition indicators and parameters and trending ;
b) Inspection programmes;
c) Surveillance programmes where appropriate;
d) Any provisions for identifying unexpected degradation.

These should include activities performed by 'third party certification organisations'.

02.3.4 Preventive and remedial actions

WENRA I3.2 *Surveillance of major structures and components shall be carried out to timely detect the inception of ageing effects and to allow for preventive and remedial actions.*

The national assessment report should address the programmatic approach for preventive and remedial actions.

02.4 Review and update of the overall AMP

WENRA I2.3 *The Periodic Safety Reviews shall be used to confirm whether ageing and wear-out mechanisms have been correctly taken into account and to detect unexpected issues.*

WENRA I2.4 *In its AMP, the licensee shall take account of environmental conditions, process conditions, duty cycles, maintenance schedules, service life, testing schedules and replacement strategy.*

WENRA I2.5 *The AMP shall be reviewed and updated as a minimum with the PSR, in order to in-corporate new information as it becomes available, to address new issues as they arise, to use more sophisticated tools and methods as they become accessible and to assess the performance of maintenance practices considered over the life of the plant.*

The NAR should address how the following processes are accomplished:

a) How licensee audit and inspection findings are implemented;
b) Evaluation of plant specific and others' operating experiences;
c) Evaluation of plant modifications that might influence the overall ageing management programme;
d) Evaluation and measurement of the effectiveness of ageing management;
e) Evaluation of ageing analyses that are time limited;
f) How current "state-of-art", including R&D results, is taken into account;
g) Consideration within the overall ageing management programme of modifications in the current licensing or regulatory framework;
h) Identification of need for further R&D.

The NAR should also address the following:

a) Strategy for periodic review of the overall AMP including potential interface with periodic safety reviews;
b) Incorporation of unexpected or new issues into the AMP;
c) Use of results from monitoring, testing, sampling and inspection activities to review the overall AMP;
d) Periodic evaluation and measurement of the effectiveness of ageing management.

02.5 Licensee's experience of application of the overall AMP

The NAR should describe whether experience has shown that changes have been needed to the organisation, content and/or structure of the overall AMP. Where experience, internal and external, has required changes to the overall AMP, the changes should be described with the reasons for them.

Conclusions on the adequacy of the overall AMP and its application to the plant(s) should be provided.

02.6 Regulatory oversight process

The NAR should describe the process for regulatory oversight. This should include:

a) Assessment of the overall AMP and its modifications;
b) Inspection of implementation of the overall AMP.

02.7 Regulator's assessment of the overall ageing management programme and conclusions

The regulator should report:

- its assessment of the ageing management processes described in this chapter;
- its experience from inspection and assessment as part of its regulatory oversight;

and present the main strengths and weaknesses that have been identified either by the licensees or the regulator on the effectiveness of the overall AMP.

The conclusions on the adequacy of the licensee's overall ageing management programme(s) should be presented.

03
Electrical cables

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It is expected that this chapter of the national assessment report will be 10 to 40 pages in length.

For guidance on the structure within sections §03.1 and §03.2 see §00.5

03.1 Description of ageing management programmes for electrical cables

03.1.1 Scope of ageing management for electrical cables

This section should consider all electrical cables important to safety for all reactor designs. It is expected that cables can be grouped, and hence not every individual cable for all reactors in a country will need to be identified. It should identify the scope of ageing management related to electrical cables by describing:

a) Methods and criteria used for selecting electrical cables within the scope of ageing management;
b) Processes/procedures for the identification of ageing mechanisms related to cables;
c) Grouping criteria for ageing management purposes.

The NAR should list the groups of electrical cables included within the ageing management in an annex. This is not expected to be more than a few pages.

To illustrate the detail of ageing management processes §03.1.2, §03.1.3, §03.1.4 and §03.2 will describe the implementation of them to a subset of cables. For §03.1.2, §03.1.3, §03.1.4 and §03.2, the NAR will focus on groups of cables important to safety in the following categories:

- High voltage cables subject to adverse environment (environment limited to the immediate vicinity that is hostile to the component material. This can be due to moisture, radiation, temperature etc.). For the purpose of the national assessment report, high voltage cables are those above about 3 kV;
- Medium voltage cables buried or in trenches. For the purpose of the national assessment report, medium voltage cables are those in the approximate range of 380 V to 3 kV;
- Neutron flux instrumentation cables.

If there are no groups of cables that match these categories, groups similar to these should be included. For example, the ranges for medium and high voltage cables are not firm limits and any cables just outside these ranges for which discussion of ageing management would make a useful contribution to the TPR should be included.

In considering ageing management of these, the scope should cover all relevant constituent elements including:

- Conductor;
- Insulation;
- Armouring/Shield;
- Jacket, sheath;
- Termination arrangements.

For §03.1.2, §03.1.3, §03.1.4 and §03.2, the selected categories of electrical cables are referred to as "NAR examples".

03.1.2 Ageing assessment of electrical cables

The NAR should describe the ageing assessments for each NAR example.

The NAR should describe the outputs from the ageing assessment including the following:

a) Ageing mechanisms requiring management and identification of their significance;
b) Establishment of acceptance criteria related to ageing mechanisms.

In describing these outputs, the NAR should explain how the following are used:

- Key standards and guidance used to prepare the SSC specific AMP, including a list of the main documents;
- Key design, manufacturing and operations documents used to prepare the SSC specific AMP;
- R&D programmes, by describing the objectives, contents and results of programmes managed by:
    - Licensees;
    - Industry or other relevant bodies;
- Internal and external operating experience, by describing why and how these experiences have been taken (or not) into account.

03.1.3 Monitoring, testing, sampling and inspection activities for electrical cables

The NAR should describe the monitoring, testing, sampling and inspection activities for each specified element for each NAR example.

The monitoring, testing, sampling and inspection activities performed by the licensee and activities performed by 'third party certification organisations' should be described including:

a) Description of activities;
b) Frequencies;
c) Acceptance criteria.

In describing these outputs, the NAR should explain how the following are used:

- Programmes for monitoring and trending including test methods available for use in performing inspections;
- Key features of the inspection programmes;
- Surveillance programmes where appropriate;
- Inspection history identifying trends and progressive deterioration;
- Any provisions for identifying any unexpected degradation.

03.1.4 Preventive and remedial actions for electrical cables

The NAR should describe key preventive and remedial actions that have been identified for each NAR example.

Description should include:

- Criteria for taking actions;
- Procedures for taking actions;
- Description of the actions to be taken.

03.2 Licensee's experience of the application of AMPs for electrical cables

The NAR should describe whether experience has shown that ageing phenomena have proceeded as predicted for each NAR example. Where experience, internal and external has required changes to the ageing management programme, the changes should be described with the reasons for them.

Conclusions on the adequacy of the SSC specific AMPs and their application to the installation(s) should be provided.

03.3 Regulator's assessment and conclusions on ageing management of electrical cables

The regulator should report:

- its assessment of the ageing management processes described in this chapter;
- its experience from inspection and assessment as part of its regulatory oversight;

and present the main strengths and weaknesses that have been identified either by the licensees or the regulator on the effectiveness of the SSC specific AMPs.

The conclusions on the adequacy of the licensee's SSC specific ageing management programme(s) should be presented.

04
Concealed pipework

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It is expected that this chapter of the national assessment report will be 10 to 40 pages in length.

For guidance on the structure within sections §04.1 and §04.2 see §00.5

04.1 Description of ageing management programmes for concealed pipework

04.1.1 Scope of ageing management for concealed pipework

This section should consider concealed pipework important to safety for all pipework designs where the pipework is:

- Buried in soil;
- Encased in concrete; or
- In covered trenches.

The NAR should identify the types of concealed pipework used by the licensees in the plants. It is expected that these can be grouped and hence not every individual type of pipework for all reactors in a country are needed to be identified. It should identify the scope of ageing management related to concealed pipework by describing:

a) Methods and criteria used for selecting concealed pipework within the scope of the ageing management;
b) Processes/procedures for the identification of ageing mechanisms related to concealed pipework ;
c) Grouping criteria for ageing management purposes.

The NAR should list the groups of concealed pipework included within the ageing management programs.

To illustrate the detail of ageing management processes §04.1.2, §04.1.3, §04.1.4 and §04.2 will describe the implementation of them to a subset of the pipework. For §04.1.2, §04.1.3, §04.1.4 and §04.2, the NAR will report on groups of concealed pipework, which:

- Contain radioactive effluents;
- Transfer fuel for emergency power generation;
- Provide essential service water providing cooling to SSCs important to safety.

If there are no concealed pipework that match these categories, other concealed pipework important to safety should be included in the NAR.

In considering ageing management of these, the scope should include “connections,” such as welds, flanges, bolts, but not include pipe supports or SSCs, such as valves or pumps within the pipework.

For §04.1.2, §04.1.3, §04.1.4 and §04.2, the selected groups of concealed pipework are referred to as "NAR examples".

04.1.2 Ageing assessment for concealed pipework

The NAR should describe the ageing assessments for each NAR example.

The NAR should describe the outputs from the ageing assessment including the following:

a) Ageing mechanisms requiring management and identification of their significance;
b) Establishment of acceptance criteria related to ageing mechanisms.

In describing these outputs, the NAR should explain how the following are used:

- Key standards and guidance used to prepare the SSC specific AMP, including a list of the main documents;
- Key design, manufacturing and operations documents used to prepare the SSC specific AMP;
- R&D programmes, by describing the objectives, contents and results of programmes managed by:
    - Licensees;
    - Industry or other relevant bodies;
- Internal and external operating experience, by describing why and how these experiences have been taken (or not) into account.

04.1.3 Monitoring, testing, sampling and inspection activities for concealed pipework

The NAR should describe the monitoring, testing, sampling and inspection activities for each specified element for each NAR example.

The monitoring, testing, sampling and inspection activities performed by the licensee and activities performed by 'third party certification organisations' should be described including:

a) Description of activities;
b) Frequencies;
c) Acceptance criteria.

In describing these outputs, the NAR should explain how the following are used:

- Programmes for monitoring and trending including test methods available for use in performing inspections;
- Key features of the inspection programmes;
- Surveillance programmes where appropriate;
- Inspection history identifying trends and progressive deterioration;
- Any provisions for identifying any unexpected degradation.

04.1.4 Preventive and remedial actions for concealed pipework

The NAR should describe key preventive and remedial actions that have been identified for each NAR example.

Description should include:

- Criteria for taking actions;
- Procedures for taking actions;
- Description of the actions to be taken.

04.2 Licensee's experience of the application of AMPs for concealed pipework

The NAR should describe whether experience has shown that ageing phenomena have proceeded as predicted for each NAR example. Where experience, internal and external has required changes to the ageing management programme, the changes should be described with the reasons for them.

Conclusions on the adequacy of the SSC specific AMPs and their application to the installation(s) should be provided.

04.3 Regulator's assessment and conclusions on ageing management of concealed pipework

The regulator should report:

- its assessment of the ageing management processes described in this chapter;
- its experience from inspection and assessment as part of its regulatory oversight;

and present the main strengths and weaknesses that have been identified either by the licensees or the regulator on the effectiveness of the SSC specific AMPs.

The conclusions on the adequacy of the licensee's SSC specific ageing management programme(s) should be presented.

05
Reactor pressure vessels

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It is expected that this chapter of the national assessment report will be 10 to 40 pages in length.

For guidance on the structure within sections §05.1 and §05.2 see §00.5

05.1 Description of ageing management programmes for RPVs

05.1.1 Scope of ageing management for RPVs

A number of designs of nuclear installations in Europe have steel reactor pressure vessels (RPV). These include PWR including VVER, BWR and possibly a few research reactors. All of these are within the scope of this chapter.

The NAR should identify the types of RPVs in nuclear installations in the country. It is expected that where there are many reactors, these can be grouped and hence not every individual RPV will need to be identified.

For each type of RPV the main structures and components that constitute the pressure boundary should be described. A principle drawing of an example of each type of RPV should be included in an annex to the NAR.

For each type of RPV, this section should identify the scope of ageing management related to the RPVs by describing:

a) Methods and criteria used for selecting components within the scope of ageing management;
b) Processes/procedures for the identification of ageing mechanisms for the different materials and components of the RPV.

To illustrate the detail of ageing management processes §05.1.2, §05.1.3, §05.1.4 and §05.2 will describe the implementation of them to a subset of the possible types of RPV covered above. Each country can select a limited representative sample of RPV for each reactor design (PWR, BWR, VVER or research reactor) with appropriate justification. For §05.1.2, §05.1.3, §05.1.4 and §05.2, the NAR will report, for each selected type, on the following elements of the RPVs:

- The steel vessel including base metal, cladding and welds;
- The vessel head and the lower dome including penetrations;
- Inlet and outlet nozzles.

For §05.1.2, §05.1.3, §05.1.4 and §05.2 these elements for the selected types of RPV are referred to as “NAR examples”.

05.1.2 Ageing assessment of RPVs

The NAR should describe the ageing assessments for each NAR example.

The NAR should describe the outputs from the ageing assessment including the following:

a) Ageing mechanisms requiring management and identification of their significance;
b) Establishment of acceptance criteria related to ageing mechanisms.

In describing these outputs, the NAR should explain how the following are used:

- Key standards and guidance used to prepare the SSC specific AMP, including a list of the main documents;
- Key design, manufacturing and operations documents used to prepare the SSC specific AMP;
- R&D programmes, by describing the objectives, contents and results of programmes managed by:
  - Licensees;
  - Industry or other relevant bodies;
- Internal and external operating experience, by describing why and how these experiences have been taken (or not) into account.

05.1.3 Monitoring, testing, sampling and inspection activities for RPVs

The NAR should describe the monitoring, testing, sampling and inspection activities for each specified element for each NAR example.

The monitoring, testing, sampling and inspection activities performed by the licensee and activities performed by 'third party certification organisations' should be described including:

a) Description of activities;
b) Frequencies;
c) Acceptance criteria.

In describing these outputs, the NAR should explain how the following are used:

- Programmes for monitoring and trending including test methods available for use in performing inspections;
- Key features of the inspection programmes;
- Surveillance programmes where appropriate;
- Inspection history identifying trends and progressive deterioration;
- Any provisions for identifying any unexpected degradation.

05.1.4 Preventive and remedial actions for RPVs

The NAR should describe key preventive and remedial actions that have been identified for each NAR example.

Description should include:

- Criteria for taking actions;
- Procedures for taking actions;
- Description of the actions to be taken.

05.2 Licensee's experience of the application of AMPs for RPVs

The NAR should describe whether experience has shown that ageing phenomena have proceeded as predicted for each NAR example. Where experience, internal and external has required changes to the ageing management programme, the changes should be described with the reasons for them.

Conclusions on the adequacy of the SSC specific AMPs and their application to the installation(s) should be provided.

05.3 Regulator's assessment and conclusions on ageing management of RPVs

The regulator should report:

- its assessment of the ageing management processes described in this chapter;
- its experience from inspection and assessment as part of its regulatory oversight;

and present the main strengths and weaknesses that have been identified either by the licensees or the regulator on the effectiveness of the SSC specific AMPs.

The conclusions on the adequacy of the licensee's SSC specific ageing management programme(s) should be presented.

06
Calandria/pressure tubes (CANDU)

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It is expected that this chapter of the national assessment report will be 10 to 20 pages in length.

For guidance on the structure within sections §06.1 and §06.2 see §00.5

06.1 Description of ageing management programmes for calandrias/pressure tubes

06.1.1 Scope of ageing management for calandrias/pressure tubes

The calandria and pressure tubes for a CANDU reactor should be described. A principle drawing of them for one reactor should be included in an annexe to the NAR.

This section should identify the scope of ageing management related to the calandrias and pressure tubes by describing:

a) Methods and criteria used for selecting components within the scope of ageing management;
b) Processes/procedures for the identification of ageing mechanisms.

To illustrate the detail of ageing management processes §06.1.2, §06.1.3, §06.1.4 and §06.2 will describe the implementation of them to a subset of the possible elements covered above as follows:

- pressure tubes;
- calandria tubes;
- feeders.

For §06.1.2, §06.1.3, §06.1.4 and §06.2, these elements are referred to as “NAR examples”.

06.1.2 Ageing assessment of calandrias/pressure tubes

The NAR should describe the ageing assessments for each NAR example.

The NAR should describe the outputs from the ageing assessment including the following:

a) Ageing mechanisms requiring management and identification of their significance;
b) Establishment of acceptance criteria related to ageing mechanisms.

In describing these outputs, the NAR should explain how the following are used:

- Key standards and guidance used to prepare the SSC specific AMP, including a list of the main documents;
- Key design, manufacturing and operations documents used to prepare the SSC specific AMP;
- R&D programmes, by describing the objectives, contents and results of programmes

managed by:
    - Licensees;
    - Industry or other relevant bodies;
- Internal and external operating experience, by describing why and how these experiences have been taken (or not) into account.

06.1.3 Monitoring, testing, sampling and inspection activities for calandrias/pressure tubes

The NAR should describe the monitoring, testing, sampling and inspection activities for each specified element for each NAR example.

The monitoring, testing, sampling and inspection activities performed by the licensee and activities performed by 'third party certification organisations' should be described including:

a) Description of activities;
b) Frequencies;
c) Acceptance criteria.

In describing these outputs, the NAR should explain how the following are used:

- Programmes for monitoring and trending including test methods available for use in performing inspections;
- Key features of the inspection programmes;
- Surveillance programmes where appropriate;
- Inspection history identifying trends and progressive deterioration;
- Any provisions for identifying any unexpected degradation.

06.1.4 Preventive and remedial actions for calandrias/pressure tubes

The NAR should describe key preventive and remedial actions that have been identified for each NAR example.

Description should include:

- Criteria for taking actions;
- Procedures for taking actions;
- Description of the actions to be taken.

06.2 Licensee's experience of the application of AMPs for calandrias/pressure tubes

The NAR should describe whether experience has shown that ageing phenomena have proceeded as predicted for each NAR example. Where experience, internal and external has required changes to the ageing management programme, the changes should be described with the reasons for them.

Conclusions on the adequacy of the SSC specific AMPs and their application to the installation(s) should be provided.

06.3 Regulator's assessment and conclusions on ageing management of calandrias/pressure tubes

The regulator should report:

- its assessment of the ageing management processes described in this chapter;
- its experience from inspection and assessment as part of its regulatory oversight;

and present the main strengths and weaknesses that have been identified either by the licensees or the regulator on the effectiveness of the SSC specific AMPs.

The conclusions on the adequacy of the licensee's SSC specific ageing management programme(s) should be presented.

07
Concrete containment structures

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It is expected that this chapter of the national assessment report will be 10 to 40 pages in length.

For guidance on the structure within sections §07.1 to §07.2 see §00.5

07.1 Description of ageing management programmes for concrete structures

07.1.1 Scope of ageing management for concrete structures

The concrete structures within the scope of this chapter are:

- concrete containment structures, with or without a liner, designed to withstand the pressure associated with a significant leakage of coolant from the reactor cooling system; and
- the concrete structure that surrounds:
    - a concrete containment structure as described in the first bullet; or
    - a (self-standing) steel containment designed to withstand the pressure associated with a significant leakage from the reactor cooling system.

  This structure is often the outer wall of the reactor building.

The NAR should identify the types of structures defined above in nuclear installations in the country. It is expected that, where there are many reactors, these can be grouped and hence not every individual structure will need to be identified.

For each type of structure within the scope of this chapter, the main functions and the main concrete structural elements should be described. A principles drawing of an example of each type of concrete structure should be included in an annex to the NAR. For designs with a steel containment, this containment should be included on the drawings.

For each type of structure within the scope of this chapter, this section should identify the scope of ageing management by describing:

a) Methods and criteria used for selecting components within the scope of the ageing management;
b) Processes/procedures for the identification of ageing mechanisms for the different materials and components of the concrete structures.

To illustrate the detail of ageing management processes, §07.1.2, §07.1.3, §07.1.4 and §07.2 will describe the implementation of them to a subset of the possible types of structures covered above. Each country can select a limited representative sample of containment designs for each reactor design (PWR including VVER, BWR, and research reactors) with appropriate justification.

For §07.1.2, §07.1.3, §07.1.4 and §07.2, for each representative sample, the NAR will report on the following elements, when applicable:

- the concrete;
- the steel reinforcement;
- the prestressing systems;
- the liner;
- the interactions of the liner with the concrete containment structure such as: anchors to the concrete (e.g. studs, structural steel shapes or other steel products), barrel-to-basemat junction;
- waterstops, seals and gaskets and protective coating.

For §07.1.2, §07.1.3, §07.1.4 and §07.2, all these elements for the selected types of concrete structures are referred to as “NAR examples”.

07.1.2 Ageing assessment of concrete structures

The NAR should describe the ageing assessments for each NAR example.

The NAR should describe the outputs from the ageing assessment including the following:

a) Ageing mechanisms requiring management and identification of their significance;
b) Establishment of acceptance criteria related to ageing mechanisms.

In describing these outputs, the NAR should explain how the following are used:

- Key standards and guidance used to prepare the SSC specific AMP, including a list of the main documents;
- Key design, manufacturing and operations documents used to prepare the SSC specific AMP;
- R&D programmes, by describing the objectives, contents and results of programmes managed by:
  - Licensees;
  - Industry or other relevant bodies;
- Internal and external operating experience, by describing why and how these experiences have been taken (or not) into account.

07.1.3 Monitoring, testing, sampling and inspection activities for concrete structures

The NAR should describe the monitoring, testing, sampling and inspection activities for each specified element for each NAR example.

The monitoring, testing, sampling and inspection activities performed by the licensee and activities performed by ‘third party certification organisations’ should be described including:

a) Description of activities;
b) Frequencies;
c) Acceptance criteria.

In describing these outputs, the NAR should explain how the following are used:

- Programmes for monitoring and trending including test methods available for use in performing inspections;
- Key features of the inspection programmes;
- Surveillance programmes where appropriate;
- Inspection history identifying trends and progressive deterioration;
- Any provisions for identifying any unexpected degradation.

07.1.4 Preventive and remedial actions for concrete structures

The NAR should describe key preventive and remedial actions that have been identified for each NAR example.

Description should include:

- Criteria for taking actions;
- Procedures for taking actions;
- Description of the actions to be taken.

07.2 Licensee's experience of the application of AMPs for concrete structures

The NAR should describe whether experience has shown that ageing phenomena have proceeded as predicted for each NAR example. Where experience, internal and external has required changes to the ageing management programme, the changes should be described with the reasons for them.

Conclusions on the adequacy of the SSC specific AMPs and their application to the installation(s) should be provided.

07.3 Regulator's assessment and conclusions on ageing management of concrete structures

The regulator should report:

- its assessment of the ageing management processes described in this chapter;
- its experience from inspection and assessment as part of its regulatory oversight;

and present the main strengths and weaknesses that have been identified either by the licensees or the regulator on the effectiveness of the SSC specific AMPs.

The conclusions on the adequacy of the licensee's SSC specific ageing management programme(s) should be presented.

08
Pre-stressed concrete pressure vessels (AGR)

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It is expected that this chapter of the national assessment report will be 10 to 20 pages in length.

For guidance on the structure within sections §08.1 and §08.2 see §00.5

08.1 Description of ageing management programmes for PCPVs

08.1.1 Scope of the ageing management for PCPVs

The NAR should identify the types of AGR PCPVs in UK.

For each type of PCPV the main elements to ensure pressure boundary integrity should be described. A principle drawing of an example of each type of PCPV should be included in an annex to the NAR.

For each type of PCPV, this section should identify the scope of ageing management related to the PCPVs by describing:

a) Methods or criteria used for selecting the components within the ageing management;
b) Processes/procedures for the identification of ageing mechanisms related to PCPVs.

To illustrate the detail of ageing management processes §08.1.2, §08.1.3, §08.1.4 and §08.2 will describe the implementation of them to a subset of the possible elements covered above. UK will select a limited representative sample of PCPVs with appropriate justification. For §08.1.2, §08.1.3, §08.1.4 and §08.2, the NAR will report, for the selected type, on the following elements of the PCPVs:

- Pre-stressed concrete vessel walls, base and top cap;
- Mass/reinforced concrete foundation disc and stressing galleries including waterstops, joint fillers and sealants;
- Pre-stressing tendons, ducts and anchorages;
- Internal insulation;
- Pressure vessel cooling system pipework inside the vessel;
- Monitoring devices embedded in the concrete;
- Rubber bearing pads supporting the vessel.

For §08.1.2, §08.1.3, §08.1.4 and §08.2, these elements for the selected type of PCPV are referred to as “NAR examples”.

08.1.2 Ageing assessment of PCPVs

The NAR should describe the ageing assessments for each NAR example.

The NAR should describe the outputs from the ageing assessment including the following:

a) Ageing mechanisms requiring management and identification of their significance;
b) Establishment of acceptance criteria related to ageing mechanisms.

In describing these outputs, the NAR should explain how the following are used:

- Key standards and guidance used to prepare the SSC specific AMP, including a list of the main documents;
- Key design, manufacturing and operations documents used to prepare the SSC specific AMP;
- R&D programmes, by describing the objectives, contents and results of programmes managed by:
  - Licensees;
  - Industry or other relevant bodies;
- Internal and external operating experience, by describing why and how these experiences have been taken (or not) into account.

08.1.3 Monitoring, testing, sampling and inspection activities for PCPVs

The NAR should describe the monitoring, testing, sampling and inspection activities for each specified element for each NAR example.

The monitoring, testing, sampling and inspection activities performed by the licensee and activities performed by 'third party certification organisations' should be described including:

a) Description of activities;
b) Frequencies;
c) Acceptance criteria.

In describing these outputs, the NAR should explain how the following are used:

- Programmes for monitoring and trending including test methods available for use in performing inspections;
- Key features of the inspection programmes;
- Surveillance programmes where appropriate;
- Inspection history identifying trends and progressive deterioration;
- Any provisions for identifying any unexpected degradation.

08.1.4 Preventive and remedial actions for PCPVs

The NAR should describe key preventive and remedial actions that have been identified for each NAR example.

Description should include:

- Criteria for taking actions;
- Procedures for taking actions;
- Description of the actions to be taken.

08.2 Licensee's experience of the application of AMPs for PVPVs

The NAR should describe whether experience has shown that ageing phenomena have proceeded as predicted for each NAR example. Where experience, internal and external has required changes to the ageing management programme, the changes should be described with the reasons for them.

Conclusions on the adequacy of the SSC specific AMPs and their application to the installation(s) should be provided.

08.3 Regulator's assessment and conclusions on ageing management of PCPVs

The regulator should report:

- its assessment of the ageing management processes described in this chapter;
- its experience from inspection and assessment as part of its regulatory oversight;

and present the main strengths and weaknesses that have been identified either by the licensees or the regulator on the effectiveness of the SSC specific AMPs.

The conclusions on the adequacy of the licensee's SSC specific ageing management programme(s) should be presented.

09
Overall assessment and general conclusions

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It is expected that this chapter of the national assessment report will be 5 to 20 pages in length.

The regulator should report its general conclusions, bringing together the outcomes of the review in the national assessment report. This should identify areas for improvement or potential good practices that have been identified in the earlier parts and any actions that result from an overview assessment of the self-assessment.

10 References

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If it is considered necessary to direct the reader to additional information, without undermining the stand-alone nature of the report, the national assessment report may make reference to other publicly available reports, including reports of national and international review missions. If feasible, any such references should be to publications available on the internet.

Annex 1
Detailed contents list for the national assessment reports

Indication:

Within each of the sections below, there may be a need to use a further level of sub-sections. These should be structured as follows:

- ***Matters common to all installations;***
- ***Commonalities to all NPPs;***
  - ***Further sub-sections grouping plants or licensees at the discretion of the member state, for example:***
    - ***Light water reactors; and/or***
    - ***PWRs, BWRs; and/or***
    - ***Licensees;***
- ***Commonalities to all research reactors;***
  - ***Further sub-sections grouping plants or licensees at the discretion of the member state.***

2.7 Regulator's assessment of the overall ageing management programme and conclusions

3 Electrical cables

3.1 Description of ageing management programmes for electrical cables
- 3.1.1 Scope of ageing management for electrical cables
- 3.1.2 Ageing assessment of electrical cables
- 3.1.3 Monitoring, testing, sampling and inspection activities for electrical cables
- 3.1.4 Preventive and remedial actions for electrical cables

3.2 Licensee's experience of the application of AMPs for electrical cables

3.3 Regulator's assessment and conclusions on ageing management of electrical cables

4 Concealed pipework

4.1 Description of ageing management programmes for concealed pipework
- 4.1.1 Scope of ageing management for concealed pipework
- 4.1.2 Ageing assessment of concealed pipework
- 4.1.3 Monitoring, testing, sampling and inspection activities for the concealed pipework
- 4.1.4 Preventive and remedial actions for concealed pipework

4.2 Licensee's experience of the application of AMPs for concealed pipework

4.3 Regulator's assessment and conclusions on ageing management of concealed pipework

5 Reactor pressure vessels

5.1 Description of ageing management programmes for RPVs
- 5.1.1 Scope of ageing management for RPVs
- 5.1.2 Ageing assessment of RPVs
- 5.1.3 Monitoring, testing, sampling and inspection activities for RPVs
- 5.1.4 Preventive and remedial actions for RPVs

5.2 Licensee's experience of the application of AMPs for RPVs

5.3 Regulator's assessment and conclusions on ageing management of RPVs

6 Calandria/pressure tubes (CANDU)

6.1 Description of ageing management programmes for calandrias/pressure tubes
- 6.1.1 Scope of ageing management for calandrias/pressure tubes
- 6.1.2 Ageing assessment of calandrias/pressure tubes
- 6.1.3 Monitoring, testing, sampling and inspection activities for calandrias/pressure tubes

Annex 2
Abbreviations used in this specification

Abbreviation	Meaning
AGR	Advanced Gas-Cooled Reactor
AMP	Ageing Management Programme
BWR	Boiling Water Reactor
CANDU	Canada deuterium-uranium reactor
ENSREG	European Nuclear Safety Regulators Group
EU	European Union
IAEA	International Atomic Energy Agency
IGALL	IAEA's International Generic Ageing Lessons Learned
MWth	MegaWatt thermal power
NAR	National Assessment Report
NPP	Nuclear Power Plant
NSD	Nuclear Safety Directive
PCPV	Pre-Stressed Concrete Pressure Vessel
PWR	Pressurised Water Reactor
R&D	Research and Development
RPV	Reactor Pressure Vessel
RL	WENRA Reference Level for Existing Reactors
SSC	System, Structure or Component important to safety as defined in 00.2
TPR	Topical Peer Review
VVER	A type of PWR (Water Water Energetic Reactor)
WENRA	Western European Nuclear Regulators Association