Ageing Management for Research Reactors

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Outline

- Introduction
- Specific considerations in ageing management in different stages of research reactor lifetime
- Elements of a systematic ageing management programme
- IAEA Safety Standards and activities on ageing management
- Concluding remarks

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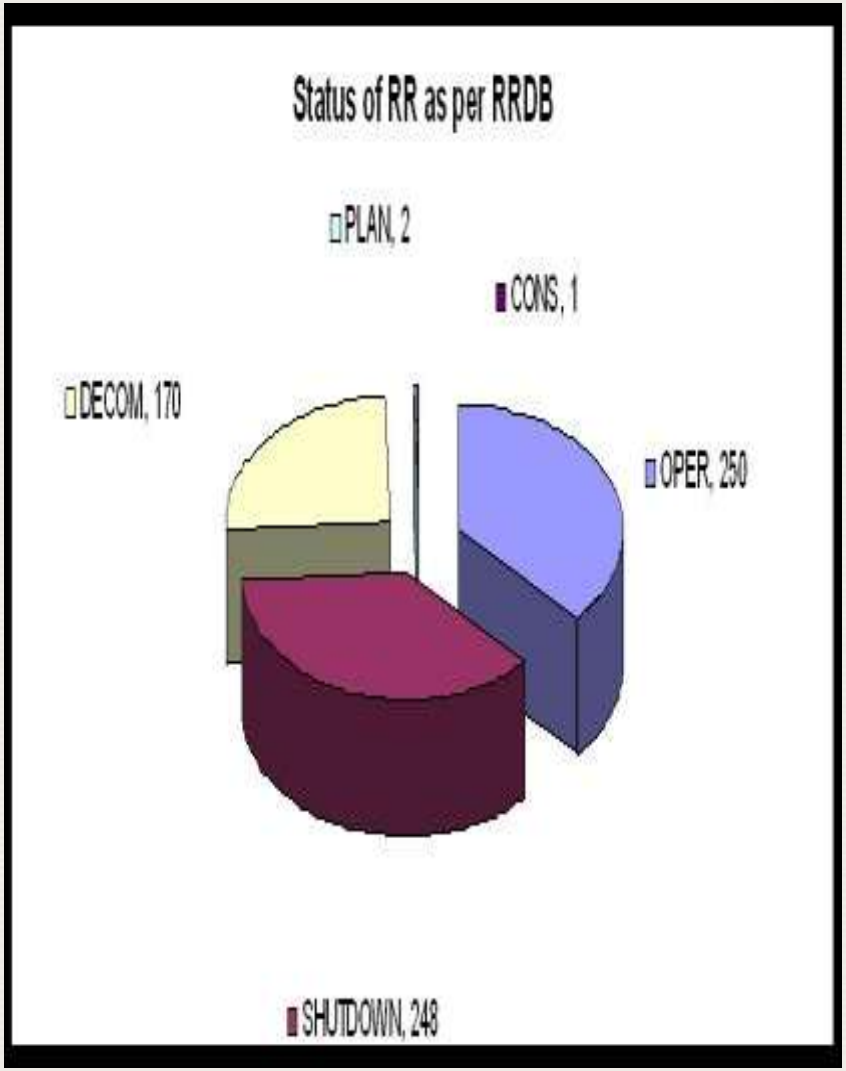
Introduction

- About 70% of the operating research reactors are more than 30 years old, with many exceeding their design life.
- The majority of these research reactors are challenged by the negative impacts of ageing.



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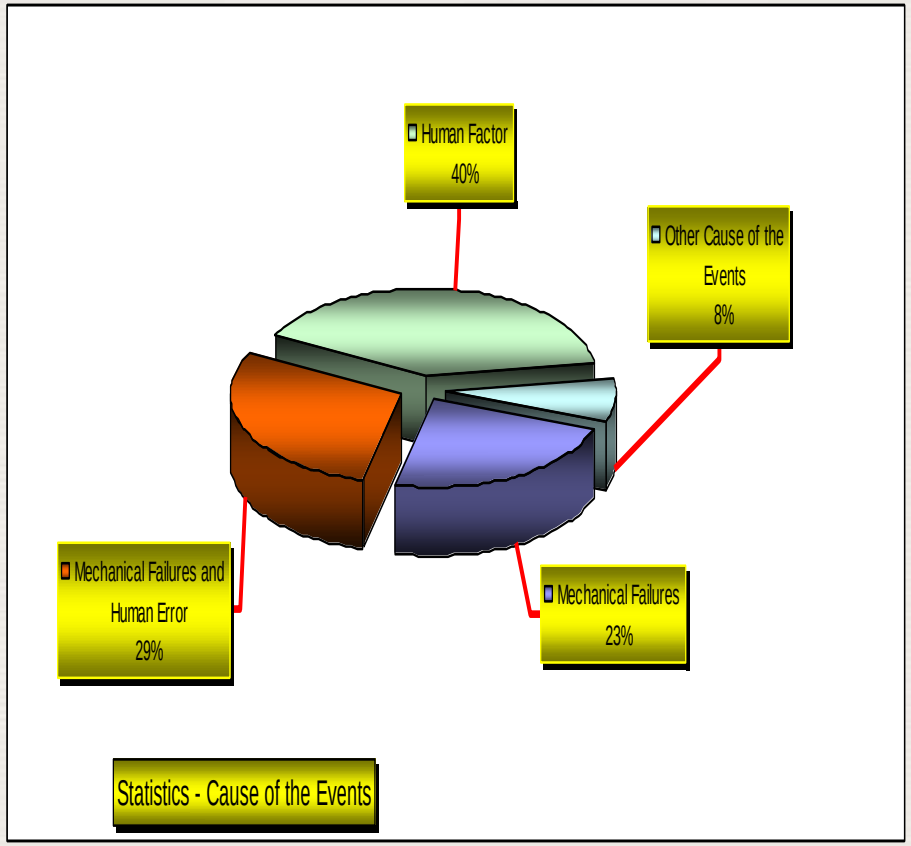
Feedback from the IAEA activities: Ageing

- IRSRR:
  Ageing of components is one of the most important root causes of the incidents reported to the IRSRR.

- Safety Review Missions:
  Need to establish a systematic ageing management programme.

- Statistics on root causes of incidents reported to IRSRR



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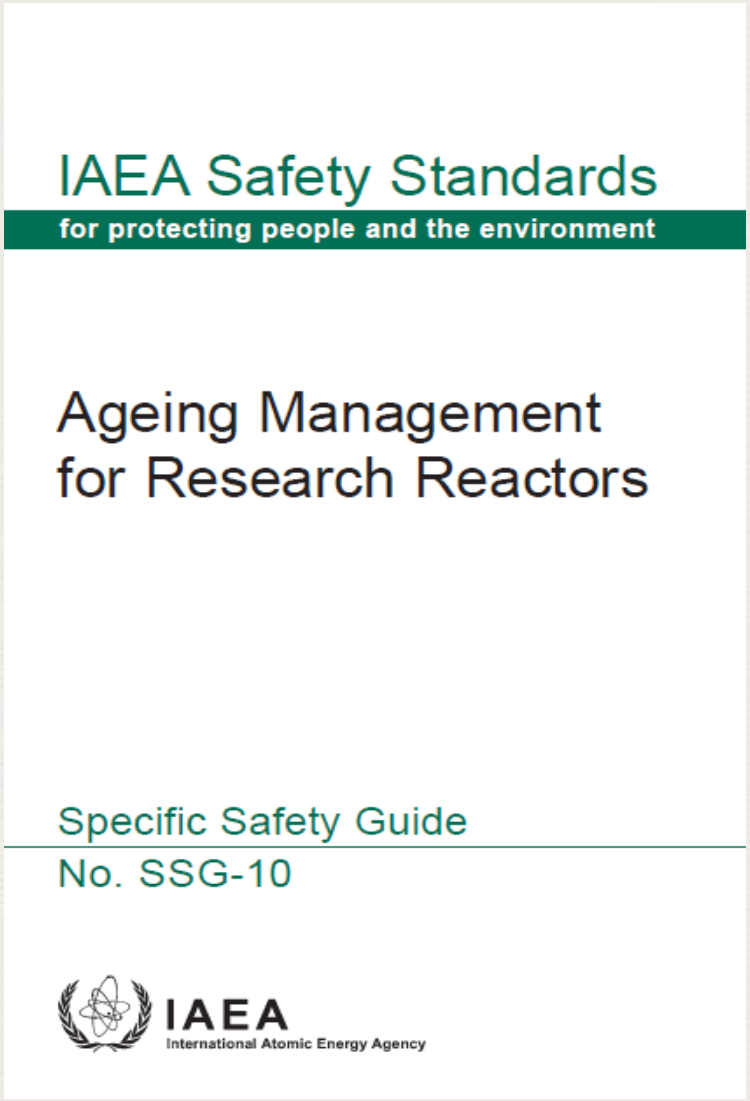
SSG-10: Ageing Management for Research Reactors

- SSG-10 Provides recommendations and practical guidance on establishing a systematic ageing management for the Structures, Systems, and Components (SSCs) important to safety.
- SSG-10 also provides guidance for managing the obsolescence.



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Ageing considerations in different stages of research reactor lifetime: Design

- The design should facilitate inspection and testing aimed at detecting ageing mechanisms and their degradation effects. This applies also to the modification projects and experimental facilities;
- Use of compatible materials and materials with greater ageing resistant properties;
- Considerations should be given to the maintenance requirements and need for material testing programmes.

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Ageing considerations in different stages of research reactor lifetime: Fabrication and construction

- Service conditions and information on possible ageing mechanisms should be taken into account;
- Records of manufacturing, inspection records, shipment and storage of SSCs should be kept as a baseline data;
- During construction, necessary surveillance specimens for specific monitoring programme should be installed in accordance with the design specifications;
- Commissioning tests should cover identification of hot spots in terms of temperature and dose rates, and measurement of vibration levels, electrical insulation, etc.

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Ageing considerations in different stages of research reactor lifetime: Operation

- Minimization of human errors that may lead to premature degradation, through continuing training, and enhancement of the safety culture;
- Optimal operation of the SSCs to slow down the rate of ageing degradation;
- Proper implementation of maintenance and periodic testing activities in accordance with the OLCs, design requirements and manufacturer's recommendations;
- Follow-up of possible degradation trends in SSCs between successive periodic testing;

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Ageing considerations in different stages of research reactor lifetime: Operation

- Use of adequate and qualified methods of non-destructive testing and ageing monitoring for early detection of flaws possibly resulting from intensive use of equipment;
- Appropriate storage of spare parts and consumables susceptible to ageing to minimize degradation while in storage and to control their shelf life properly;
- Feedback of operating experience (both reactor specific and generic, including similar RRs, NPP, and industrial plants).

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Elements of Ageing Management Programme (SSG-10)

- Screening of SSCs for ageing management review:
  - Based on importance to safety;
  - Takes into consideration the SSCs replacement ease.
- Minimization of expected ageing degradation:
  - Prevention actions should have been defined at the design stage;
  - Periodic review of the effectiveness of these actions.
- Detection, monitoring and trending of ageing degradation:
  - Inspections;
  - Monitoring;
  - Performance tests;
  - Periodic testing.

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Elements of Ageing Management Programme (SSG-10)

- Mitigation of ageing degradation:
  - Periodic replacement of components;
  - Refurbishment and modification;
  - Altering of operating conditions and practices.
- Continuous improvement of the ageing management programme:
  - Feedback experience;
  - Review of programme effectiveness.
- Record keeping.

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Interfaces of ageing management with other technical areas

Ageing management could be achieved by integration of the following technical areas:

- *Maintenance, periodic testing and inspection;*
- *Periodic safety review;*
- *Equipment qualification;*
- *Reconstitution of the design basis;*
- *Configuration management;*
- *Continued safe operation.*

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Management of obsolescence

Condition	Action
Changes in technology	- Ensure systematic identification of useful service life and anticipated obsolescence; - Prepare modification projects; - Provide spare parts for the planned service lifetime/identify alternative suppliers.
Changes in safety requirements and regulations, advances in knowledge	- Ensure compliance with current safety standards and regulations; - Consider modification of SSCs important to safety as required.
Documentation becoming out of date	- Ensure establishment of an effective management system.

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Other IAEA Safety Standards Relevant to Ageing Management for Research Reactors

IAEA Safety Standards for research reactors – January 2012

NS-R-4– Requirements on the "Safety of Research Reactors"

Safety Assessment of RRs and Preparation of the SAR
SS-35-G1

Utilization and Modification of RRs
SS-35-G2

Maintenance Periodic Testing and Inspections of RRs
NS-G-4.2

Commissioning of RRs
NS-G-4.1

The Operational Limits and Conditions and Operating Procedures for RRs
NS-G-4.4

The OO and Recruitment, Training and Qualification of Personnel for RRs
NS-G-4.5

Core Management and Fuel Handling for RRs
NS-G-4.3

Radiation Protection and Waste Management in the Design and Operation of RRs
NS-G-4.6

Decommissioning of NPPs and RRs(1999)
WS-G-2.1

Ageing Management for Research Reactors
SSG-10

Use of a graded approach in the application of Safety Requirements for RRs

(approved for publication)

Safety of I&C and Software Important to Safety
(in the drafting stage)

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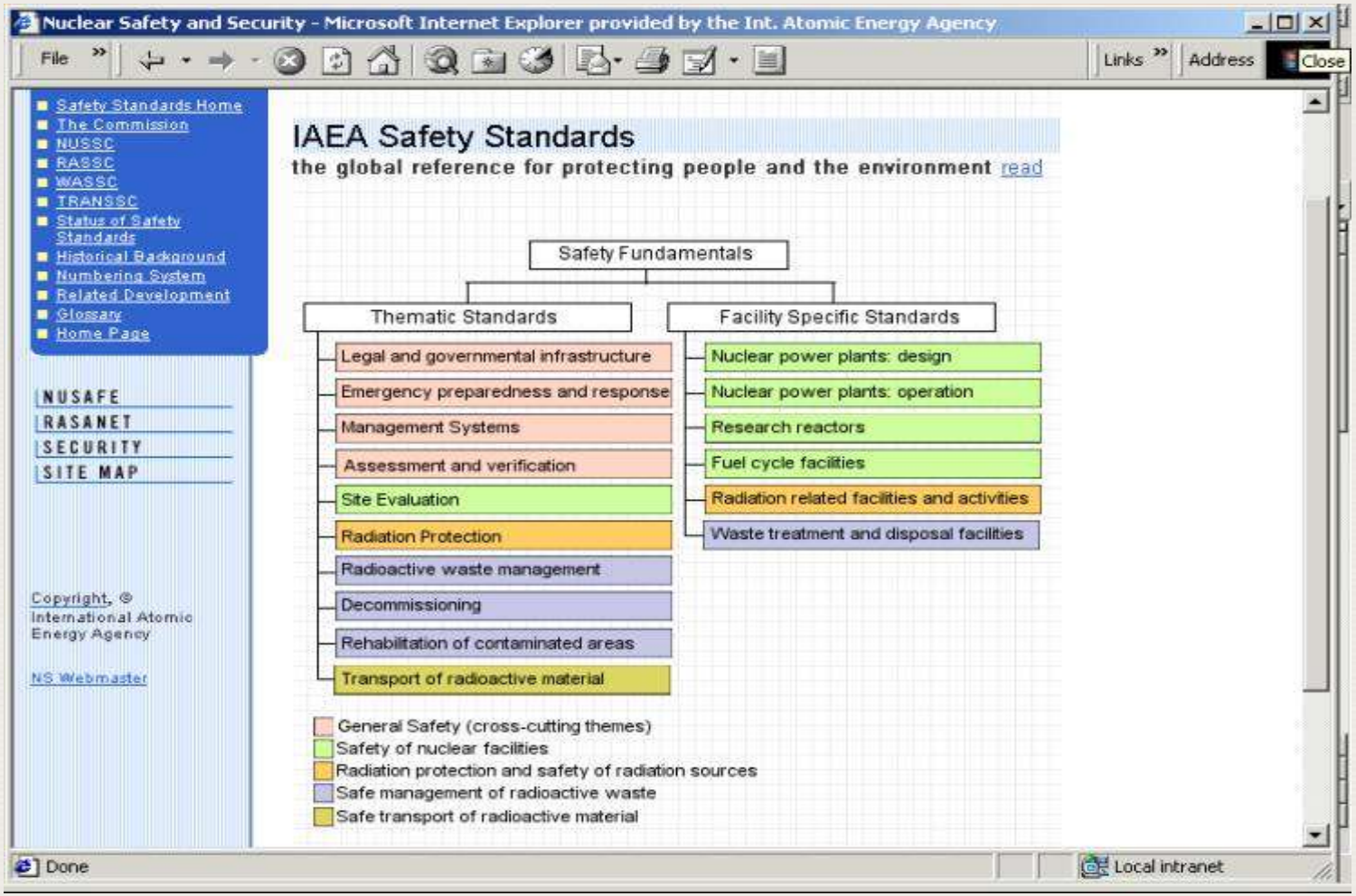
http://www-ns.iaea.org/standards/



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Other IAEA publications on ageing management for RRs

- TECDOC 1263:
  Application of Non-destructive Testing and In-Service Inspection to Research Reactors;
- TECDOC 1387:
  Safety Considerations for Research Reactors in Extended Shutdown.
- TECDOC 1625:
  Research Reactor Modernization and Refurbishment.

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IAEA activities on research reactor ageing management

- Development and help implement Safety Standards;
- Assistance to operating organizations in establishing systematic ageing management programmes and to regulatory bodies in reviewing the programme and verifying its implementation;
- Implementation of training workshops/technical and regional meetings on ageing management and periodic safety reviews;
- INSARR missions: Ageing management is one of the review areas.

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Concluding remarks

- Ageing management of SSCs should be implemented proactively through out the lifetime of a RR project. This also applies to refurbishment and modernization projects.

- In practice, ageing management programme is accomplished by:

  - *Coordinating existing programmes, including maintenance, periodic testing and inspection and periodic safety reviews;*
  - *Applying good operational practices;*
  - *Incorporating lessons learned from operating experience.*

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Concluding remarks

- Modification projects of major safety significance should be subjected to review and assessment by safety authorities, and to procedures for design, fabrication and construction, commissioning, and safety analysis, as applied to the reactor itself.

- Refurbishment and modernization projects should not be limited to a pure replacement of SSCs. They should also seek for safety improvements to comply with the up-to-date safety requirements and criteria, including the IAEA Safety Standards.

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Thank you for your attention!

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