IAEA
International Atomic Energy Agency

IAEA Safety Standards and Services on

Ageing Management for Research Reactors

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IAEA Technical Meeting on
Research Reactor Ageing Management,
Refurbishment and Modernization
31 May – 4 June 2021

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- Ageing and Safety
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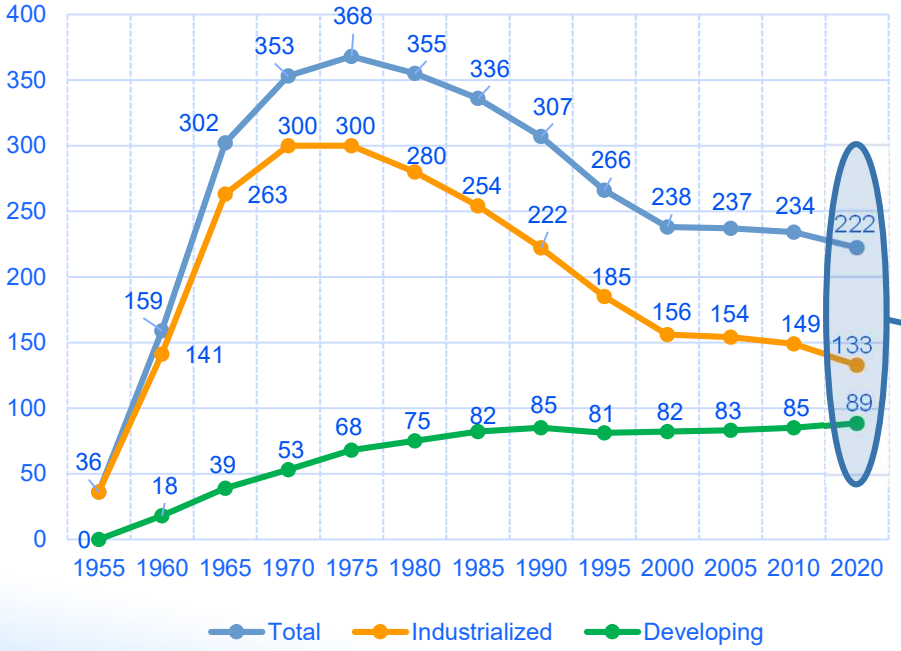
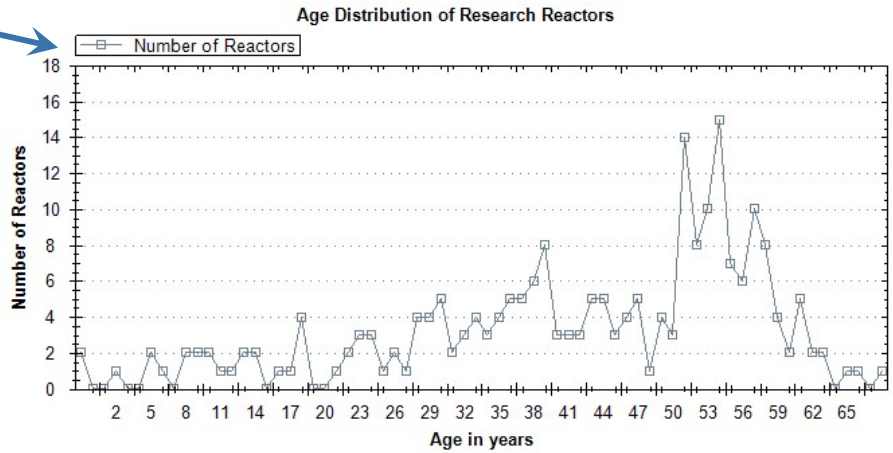
Research Reactors Worldwide

Number of operational RRs in industrialized and developing countries



https://nucleus.iaea.org/RRDB/ (March 2021)

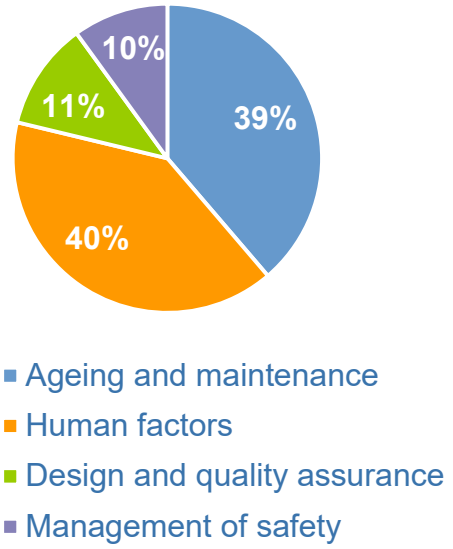
- The number of operational research reactors (RRs) peaks in the 70s
- ~ 70% of the currently operational RRs are older than 40 years



Ageing and Safety

- Ageing is one of the main causes of events (~ 40%) reported to IRSRR
  - Inadequate actions to minimize degradation mechanisms
  - Inadequate activities to detect degradation mechanisms
  - Inadequate maintenance programme
- Ageing is also one of the main causes for unplanned shutdown & outage of research reactors, which result in reduced availability (caused shortage of medical isotope production in 2008-2010)
- Ageing is one of the main reasons for developing Code of Conduct on the Safety of Research Reactors
- Ageing of SSCs affect achieving the defense-in-depth objectives

Cause of the events



[IAEA-TECDOC-1762]

Towards Effective Ageing Management

- An effective ageing management programme contributes to ensure the three main safety functions for all states of the facility (including design extension conditions)
- In practice, ageing management programme (AMP) can be enhanced by coordinating existing programmes (such as periodic safety review and maintenance, periodic testing and inspection programmes) as well as by applying good operational practices (from its own experience), lessons learned from other facilities, and research and development
- AMP should incorporate practices to minimize degradation mechanisms, detect, monitor and assess status of SSCs and mitigate measures such as refurbishment & modernization
- Feedbacks from IAEA review missions showed progress of implementing refurbishment & modernization activities, but still lack of establishing a systematic and proactive AMP

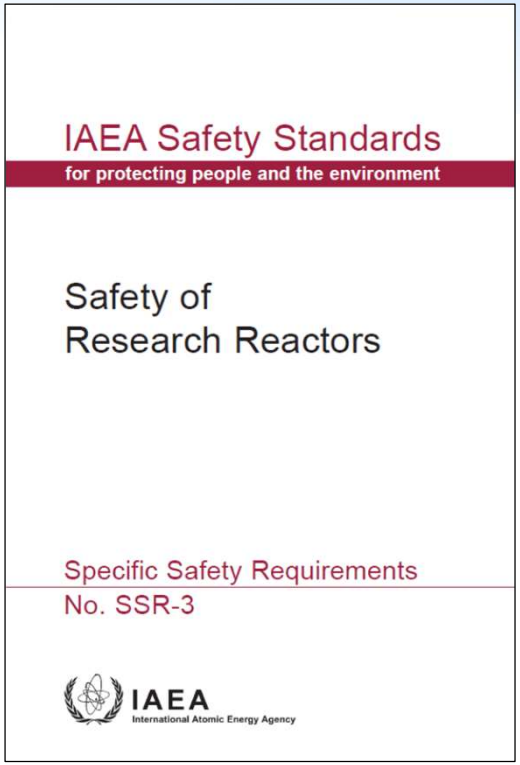
IAEA Safety Standards and Services

- Safety Standards and technical publications
  - SSR-3 and SSG-10
  - NS-G-4.2, SSG-37, SSG-22, SRS-99, TECDOC-1748, TECDOC-1625, …
- Peer review and expert advisory missions
  - INSARR & SALTO
  - Recent expert missions to Egypt and Morocco
- Capacity building activities
  - Technical meeting and training
  - Research Reactor Ageing Database (RRADB)
  - Coordinate Research Project (CRP)

SSR-3

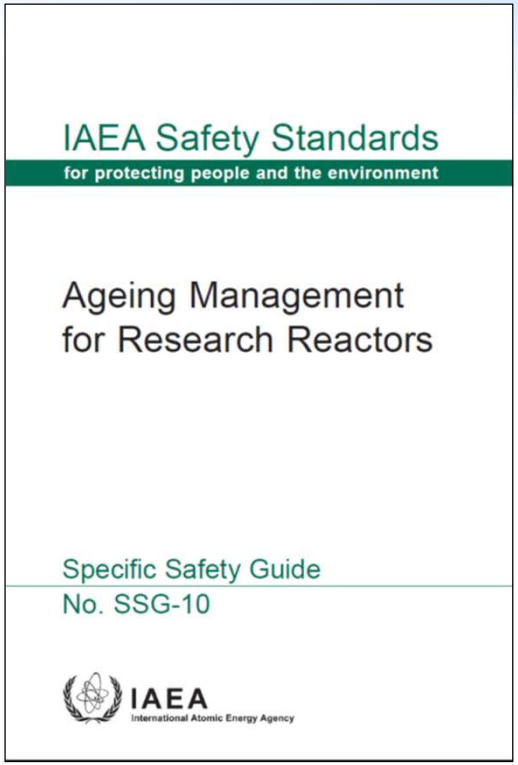
- **Requirement 37: Design for Ageing Management**
  "The design life of items important to safety at a research reactor facility shall be determined. Appropriate margins shall be provided in the design to take due account of relevant mechanisms of ageing, such as ... ... The life cycles of the technology utilized and the possible obsolescence of the technology shall be considered."

- **Requirement 86: Ageing Management**
  "The operating organization for a research reactor facility shall ensure that an effective ageing management programme is implemented to manage the ageing of items important to safety ... …"

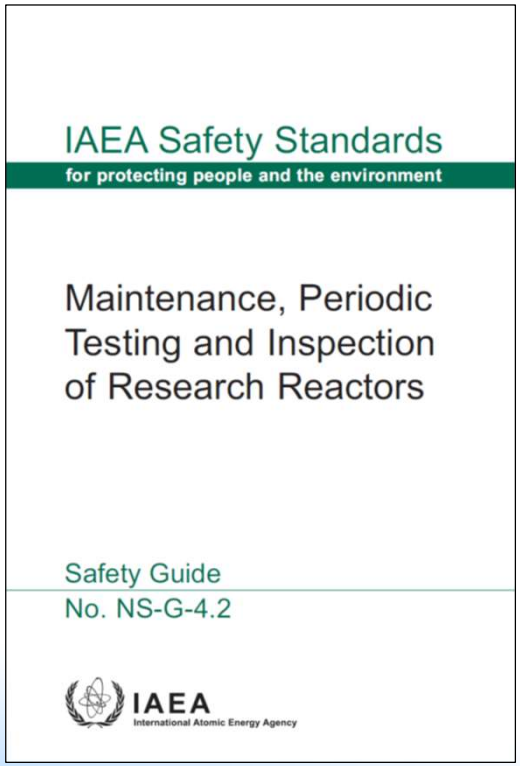


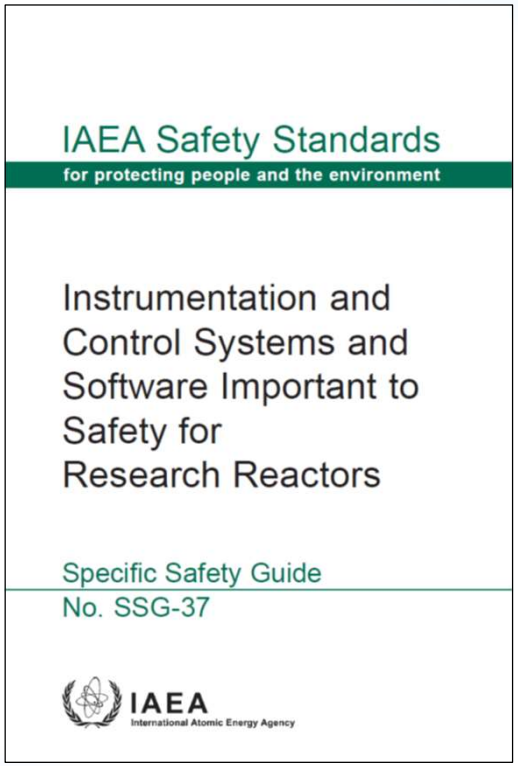
SSG-10

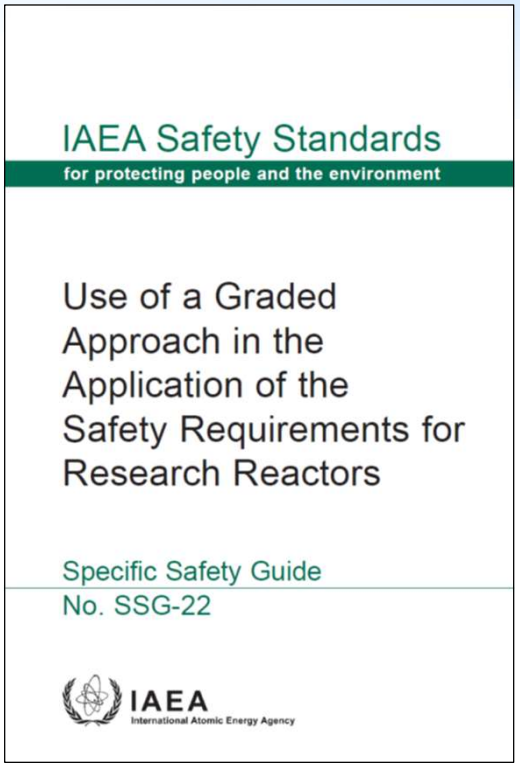
- Provides recommendations on managing ageing of SSCs important to safety at research reactors on the basis of international good practice
- Contributes to the enhancement of SSCs long term reliability and availability
- Intended for use by **operating organizations** in establishing, implementing and improving ageing management programme and by **regulatory bodies** in verifying that ageing is being effectively managed
- Revision is ongoing to incorporate experience from its use and lessons learned from the Fukushima accident



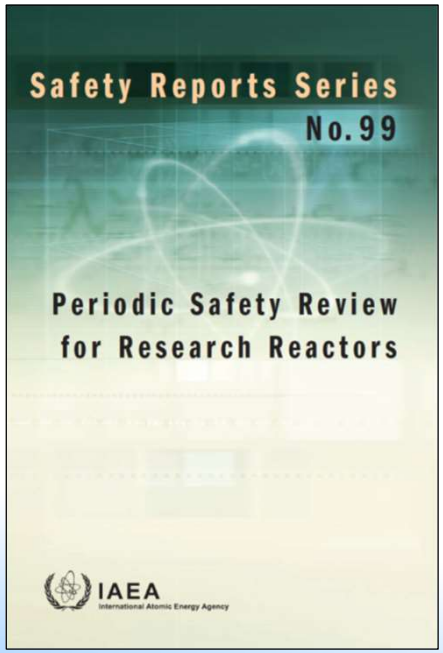
Other Relevant IAEA Safety Standards

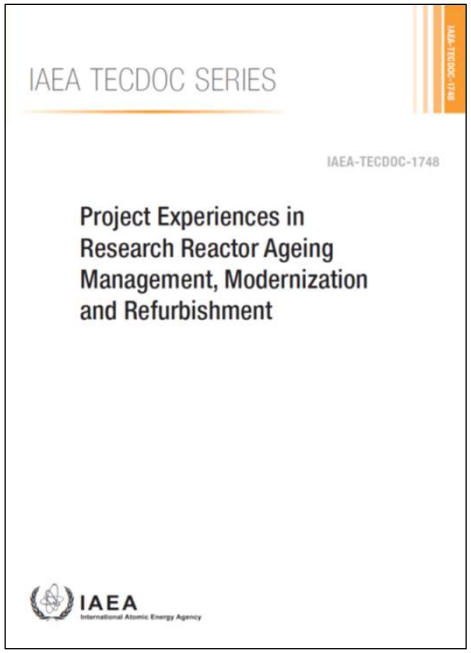


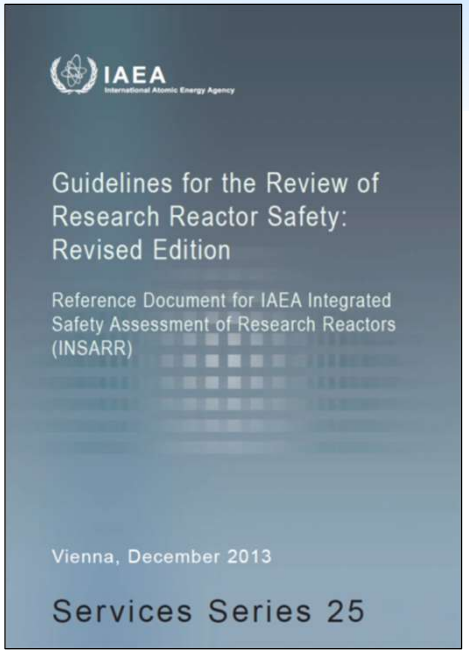




Other Relevant IAEA Publications







Peer Review: INSARR Mission

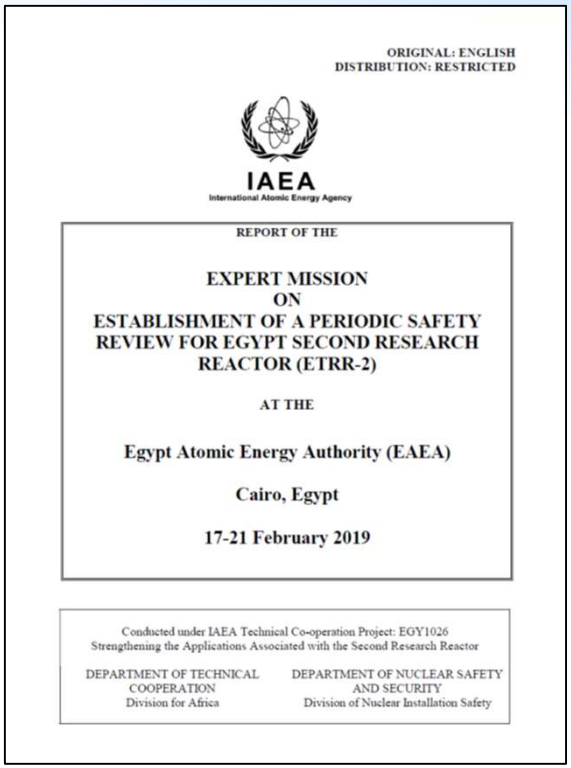
- Assesses research reactor safety against IAEA Safety Standards
- Covers ageing effect by evaluating the preparation and implementation of inspection, periodic testing and maintenance programmes
- Also covers areas interfacing with ageing (e.g., management system, documentation, procedures, etc.)
- Recent INSARR missions include Czech Republic (2020), Nigeria (2019), Congo (2018), …

Peer Review: SALTO-RR Mission

- Adopted SALTO mission for evaluating research reactors ageing management since 2017
- Utilizes experience from NPP
- The first mission implemented at BR2, Belgium (2017)
- Further missions are planned for HFR, the Netherlands and WWR-SM, Uzbekistan

Expert Advisory Mission

- IAEA supports the implementation of PSR in research reactors, where “Ageing” is one of 14 safety factors, with expected outcome of determining any SSCs important to safety may be vulnerable in the specified period
- Two expert missions in 2019 (Egypt and Morocco)
- Multiple workshops and technical meetings for PSR knowledge and experience exchange in Asia, Europe, and Africa, including a virtual workshop (100+ participants) in 2020
- Safety Reports Series No. 99 “Periodic Safety Review for Research Reactors” (November 2020)



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REPORT OF THE

EXPERT MISSION
ON
ESTABLISHMENT OF A PERIODIC SAFETY REVIEW FOR EGYPT SECOND RESEARCH REACTOR (ETRR-2)

AT THE

Egypt Atomic Energy Authority (EAEA)

Cairo, Egypt

17-21 February 2019

Conducted under IAEA Technical Co-operation Project: EGY1026
Strengthening the Applications Associated with the Second Research Reactor

DEPARTMENT OF TECHNICAL COOPERATION
Division for Africa

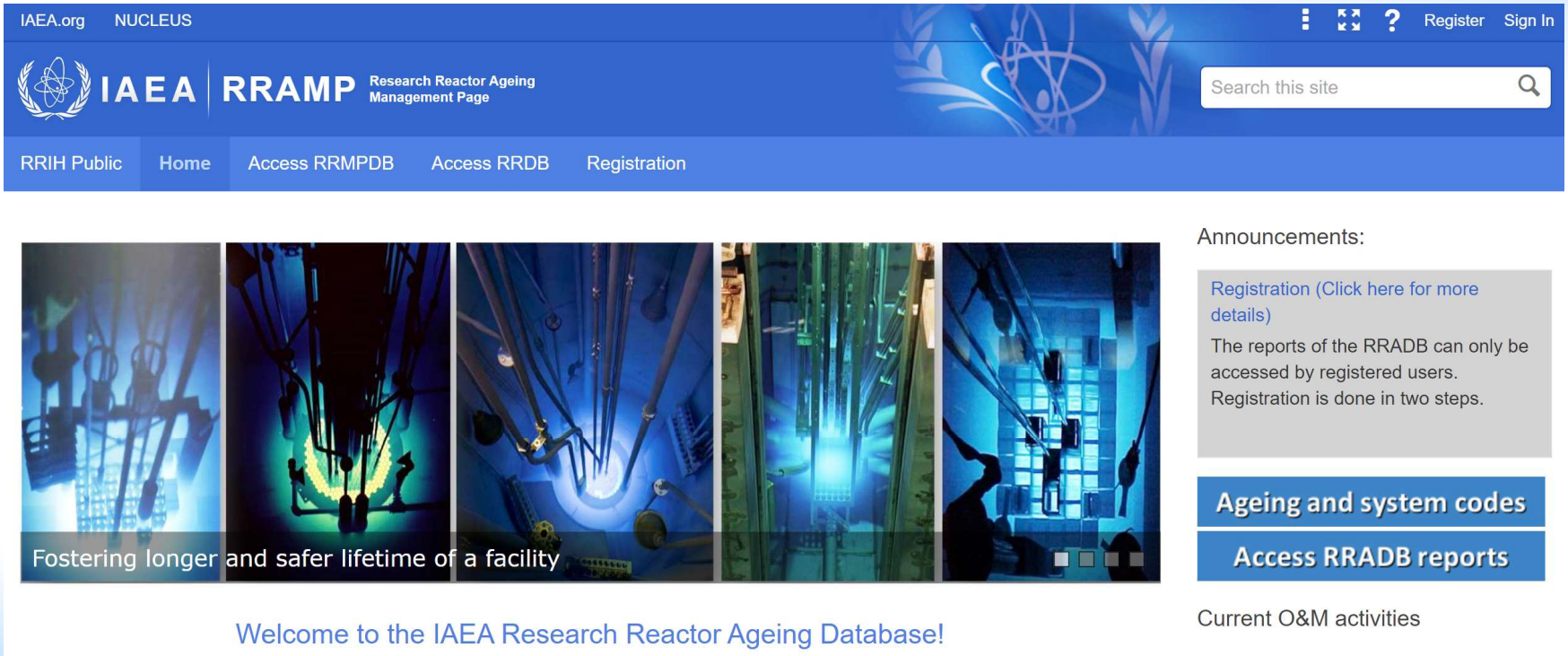
DEPARTMENT OF NUCLEAR SAFETY AND SECURITY
Division of Nuclear Installation Safety

Technical Meeting and Training

- Considered as important capacity building activities
- Regularly conducts Technical Meeting on Research Reactor Ageing Management, Refurbishment & Modernization
- Ageing management is included a module in the training material on regulatory inspection of research reactors

RRADB: Research Reactor Ageing Database

https://nucleus.iaea.org/sites/rramp/Pages/Home.aspx



Register and Contribute to the database by sending email to RRADB.Contact-Point@iaea.org

CRP: Coordinate Research Project

- "Establishment of Material Properties Database for Irradiated Core Structural Components for Continued Safe Operation and Lifetime Extension of Ageing Research Reactors"

- Specific objectives include:
  - Obtain data on RR material properties
  - Collect relevant irradiation data
  - Evaluate and identify data gaps
  - Compile a shared database

- Project outcomes include:
  - TECDOC-1871 published in 2019
  - IAEA RRMPDB (Research Reactor Material Properties Database) developed

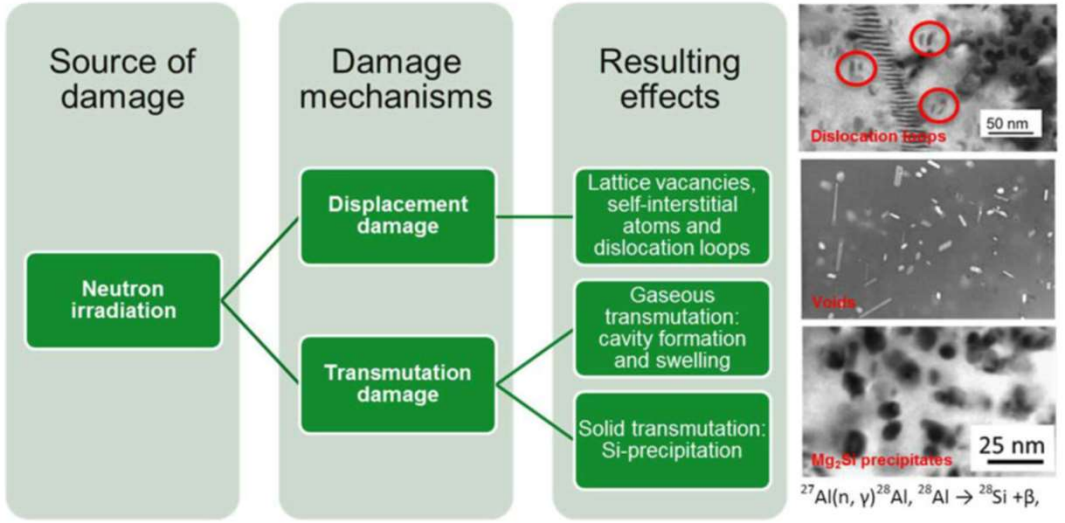


FIG. 1. Damage mechanisms and resulting effects of neutron irradiation on aluminium alloys (Courtesy of M. Kolluri).

[IAEA-TECDOC-1871]

Concluding Remarks

- An effective ageing management programme could contribute to ensure safety and enhance availability of research reactors
- Ageing management programme interfaces with other existing programmes, e.g., periodic safety review and maintenance, periodic testing and inspection programmes
- Effective ageing management should not only focus on refurbishment & modernization of SSCs, but also conduct safety upgrade in accordance with up-to-date Safety Standards
- IAEA offers various peer-review and expert advisory missions for establishing systematic and proactive ageing management
- We encourage your contributions to the RRADB

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Ageing may not be avoidable

but it is **manageable**

if there is an effective **programme** in place

Thank you!