

# IAEA SUPPORT ACTIVITIES FOR RESEARCH REACTORS

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**IAEA**

International Atomic Energy Agency

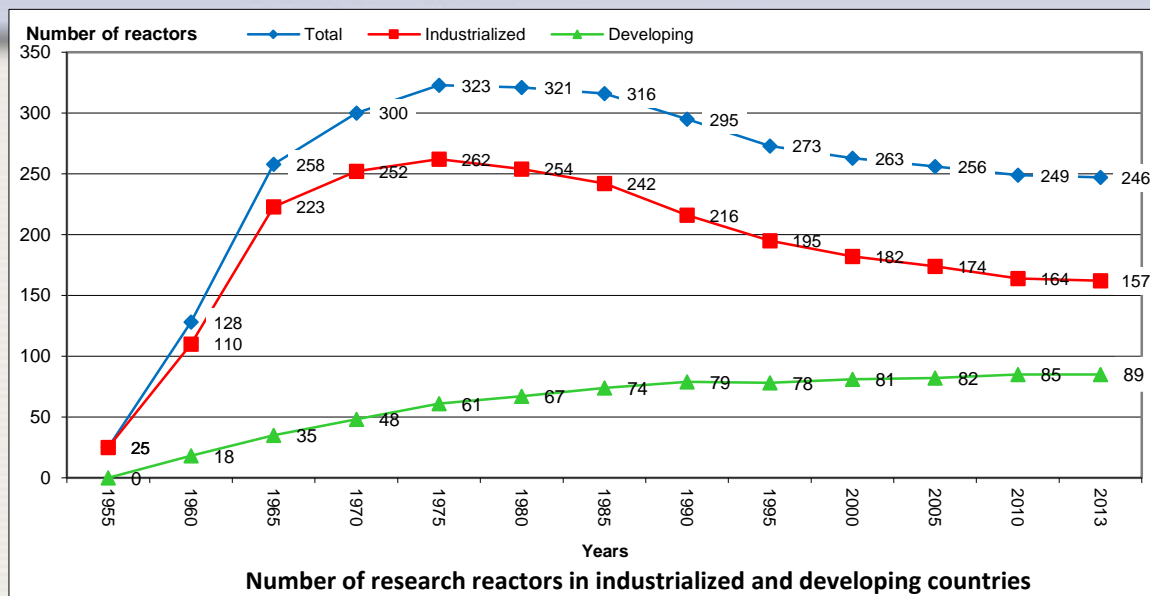
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# Background

- For more than 60 years, research reactors have been centres of innovation and productivity for nuclear science and technology programmes in **67 countries** around the world
- Research reactors have been providing a **multidisciplinary environment** which triggers **countries' industrial** (nuclear and non-nuclear), **medical** (diagnostic and therapy) and **agricultural** development
- They also have been serving as **major facilities for nuclear education and training** of young generations of scientists and technicians, and **have been contributing to build expertise and national infrastructure to support nuclear power programmes**
- According to the IAEA Research Reactor Database (RRDB), out of 754 research reactors built around the world, **246 are currently in operation in 55 countries** (including critical and sub-critical facilities)

# Background



Source IAEA RRDB – Data include Critical and Sub-critical Facilities  
<http://nucleus.iaea.org/RRDB/RR>

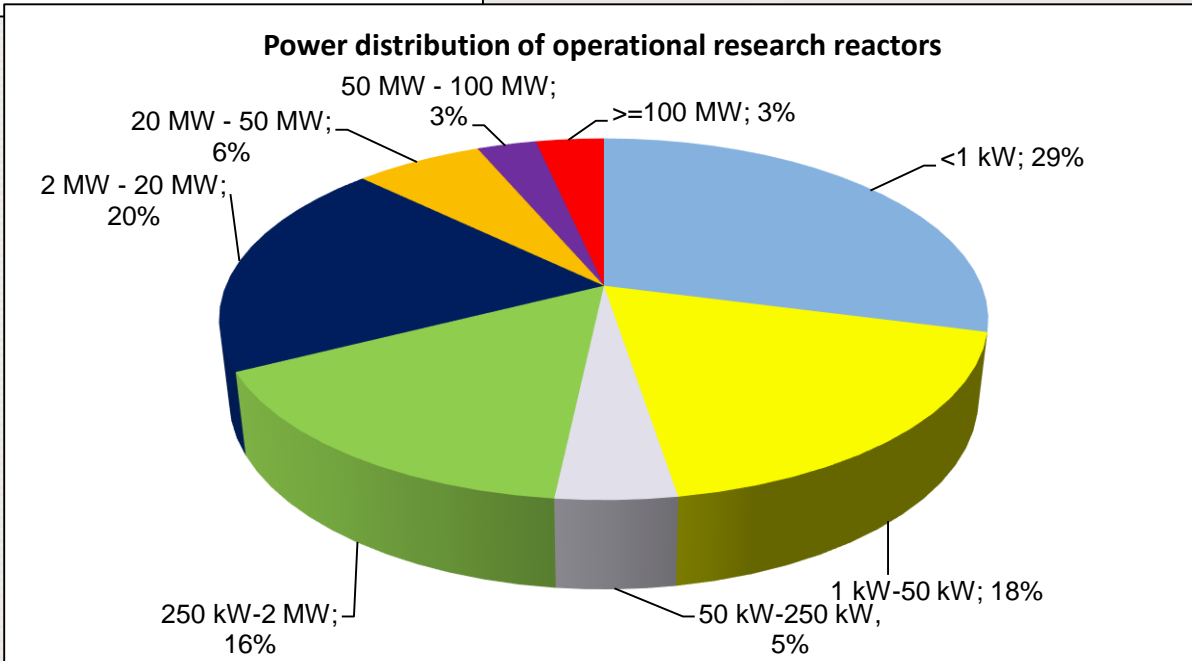
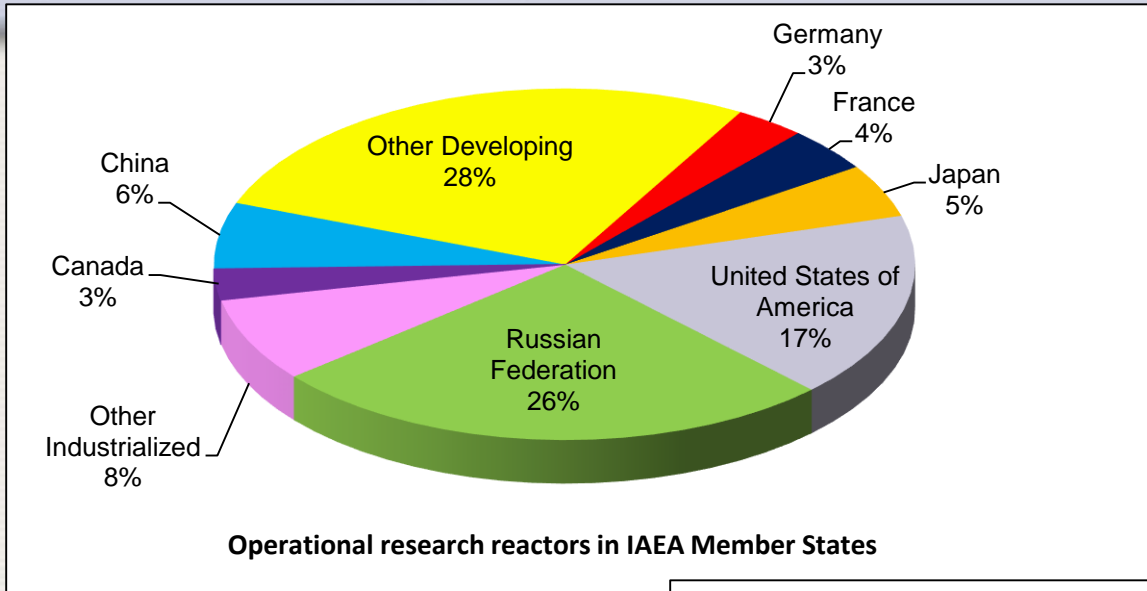
Status	Industrialized Countries	Developing Countries	All Countries
<b>Operational</b>	<b>157</b>	<b>89</b>	<b>246</b>
Temporary shutdown	13	6	19
Shut down	119	21	140
Under Decommissioning	318	25	343



Currently, there are **29 IAEA Member States** considering embarking or already embarked on new research reactor projects; out of these, **13 are newcomers to nuclear technology**



# Background



Source IAEA RRDB Data include Critical and Sub-critical Facilities

<http://nucleus.iaea.org/RRDB/RR>

# Background

Operating research reactors are used for a large number of applications

Type of Application	Number of Research Reactors involved (multiple entries)
Isotope Production	100
Neutron Scattering	52
Neutron Radiography	74
Material Irradiation	156
Transmutation (Gems)	21
Transmutation (NTD)	30
Teaching/Training	178
NAA	128
Geochronology	27
Neutron therapy	19
Nuclear Data Provision	2
Innovative Research	13

*Source IAEA RRDB*

<http://nucleus.iaea.org/RRDB/RR>

# Overview of IAEA Supporting Activities

🚩 In order to promote **research reactors sustainability**, the IAEA assists **Member States with a “one-house approach”** that involves all three technical Departments (**Dep. of Nuclear Energy, Nuclear Science and Applications, Nuclear Safety and Security**), the **Department of Technical Cooperation**, the **Department of Safeguards** and the **Office of Legal Affairs**

- 🚩 Specifically, the IAEA assists Member States in their efforts
- to enhance safety and security
  - to enhance utilization
  - to plan and implement new research reactor projects
  - to address research reactors' fuel cycle issues (front-end and back-end, HEU to LEU conversion)
  - To develop LEU targets for radioisotopes production
  - to improve operational performances, and to establish effective maintenance and ageing management plans

# Overview of IAEA Supporting Activities



Assistance is provided by the IAEA through several “tools”, such as:

- **Reference technical documents, guides and standards**
- **Expert missions**
- **Training courses and fellowships**
- **Scientific visits**
- **Technical meetings, training workshops and thematic conferences**
- **Coordinated Research Projects (CRPs)**
- **Research reactor coalitions and networks**
- **Research Reactor Data Base (RRDB), Research Reactor Ageing Data Base (RRADB), Research Reactor Material Properties Data Base (RR-MPDB)**
- **Procurement of specific equipment**



# IAEA Project on Enhancement of Utilization of Research Reactors

- ▶ **Effective utilization** of research reactors persists as a primary concern since it is the basis for sustainable operation
- ▶ A large number of research reactors around the world are **still not utilized to their full potential**
- ▶ The IAEA responds to such a challenge with a broad range of activities aiming at assisting Member States in:
  - Developing effective **Strategic and Business Plans** for facility's utilization
  - Expanding **Stakeholders base and support**
  - **Increasing local competences** on applications of research reactors
  - **Enlarging the offer of services and products** by implementing new experimental devices and/or improving the existing capacities (e.g. QA and automation in neutron activation analysis; applications of neutron beams and standardization of digital neutron imaging; proficiency testing campaigns; **CRP** on “Development of an Integrated approach to Routine Automation of Neutron Activation Analysis”)

# IAEA Project on Enhancement of Utilization of Research Reactors

- 🚩 To foster regional cooperation and support facilities in expanding their stakeholder base and user community, the IAEA also **promotes the development of research reactor networks and coalitions**



- |    |               |                                  |        |
|----|---------------|----------------------------------|--------|
| 1. | <b>EERRI</b>  | Eastern European RR Initiative,  | 6 MS   |
| 2. | <b>CRRC</b>   | Caribbean RR Coalition,          | 3 MS   |
| 3. | <b>EARRC</b>  | Eurasian RR Coalition,           | 5 MS   |
| 4. | <b>BRRN</b>   | Baltic Research Reactor Network, | 10 MS  |
| 5. | <b>MRRN</b>   | Mediterranean RR Network,        | 12 MS  |
| 6. | <b>CARRN</b>  | Central Africa RR Network,       | 9 MS   |
| 7. | <b>CISRRC</b> | CIS RR Coalition,                | 8 MS   |
| 8. | <b>GTRRN</b>  | Global TRIGA RR Network,         | +14 MS |

# IAEA Project on Research Reactor Infrastructure, Planning and Capacity Building

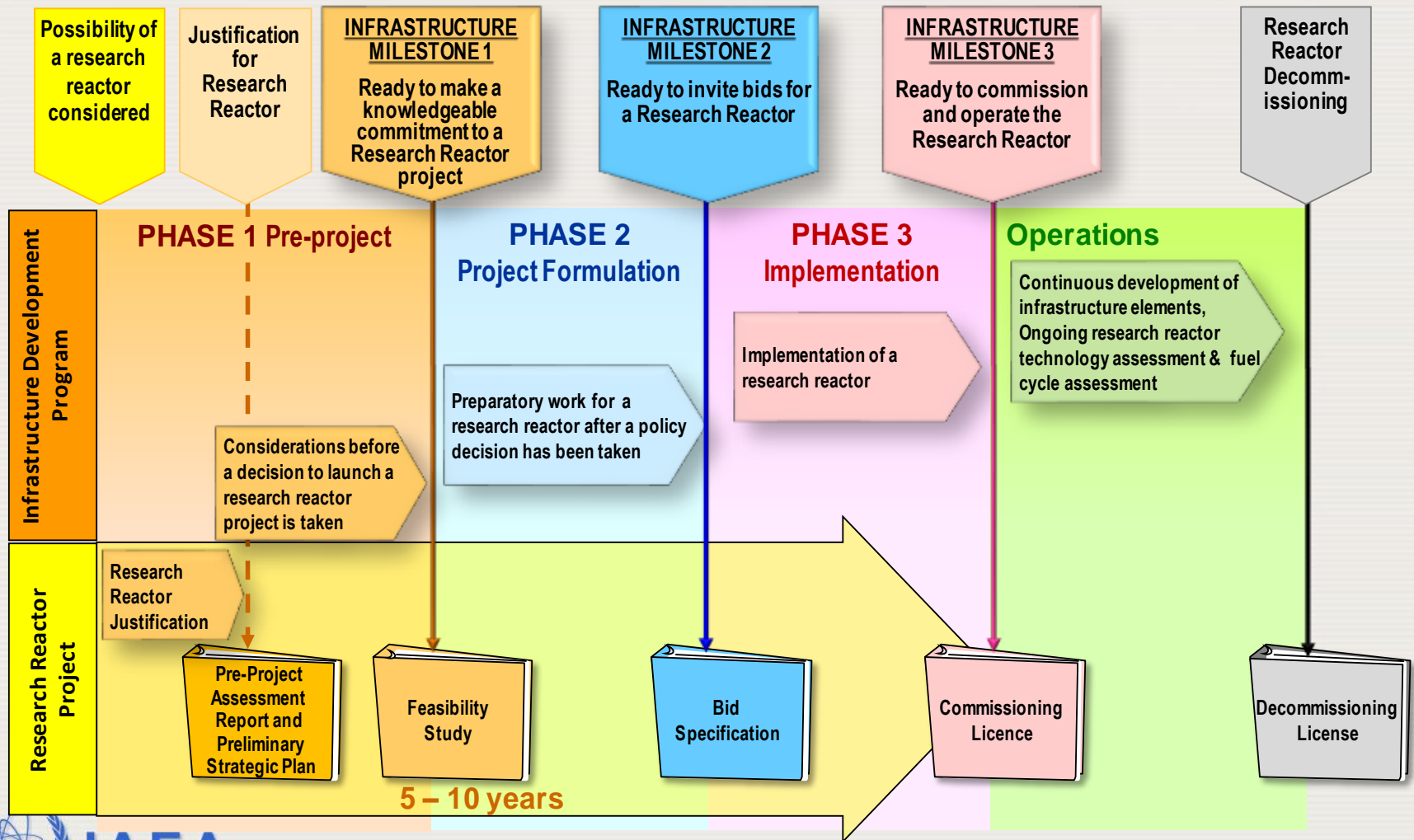
- ▶ **A research reactor project is a major national undertaking** that requires careful preparation, planning, implementation and investment of time, money, and human resources
- ▶ In recent years the interest of IAEA Member States in developing research reactor programmes has grown significantly, and currently several Member States are in different stages of new research reactor projects
- ▶ **Approximately half of these countries are building their first research reactor** as a key national facility for the development of their nuclear science and technology programmes, including nuclear power
- ▶ The major objective of this project is to **assist Member States to plan and implement new research reactor projects, including providing guidance for assessment and development of all components of their national nuclear infrastructure**

# The IAEA Project on Research Reactor Infrastructure, Planning and Capacity Building

- Assistance is provided to Member States in the framework of the **IAEA-developed Research Reactor Milestones approach** (NES Report No. NP-T-5.1 - *Specific Considerations and Milestones for a Research Reactor Project*)
- This approach provides comprehensive guidance on the **timely preparation of a new research reactor project through specific development phases**, including the range of **national infrastructure issues** that need to be addressed, and the expected level of achievement (or **milestones**) at the end of each phase of the project
- Additional publications and services** have been developed/are under development. This includes the **Integrated RR Infrastructure Assessment (IRRIA) Mission** and publications such as: “Assessment of the National Nuclear Infrastructure to Support a New Research Reactor Project”, “Preparation of a Feasibility Study for a New Research Reactor Project”, “Technical Requirements in the Bidding Process for a New Research Reactor” (NP-T-5.6), Project Management in Research Reactor Construction, “Applications of Research Reactors” (NP-T-5.3), “Strategic Planning for Research Reactors”

# The IAEA Project on Research Reactor Infrastructure, Planning and Capacity Building

## Research Reactor Project and Infrastructure Development Programme



# The IAEA Project on Research Reactor Infrastructure, Planning and Capacity Building

- ▶ The IAEA continues to support nuclear capacity building through the Eastern European Research Reactor Initiative (**EERRI Group Fellowship Training Programme**) (a six-week hands-on training course on research reactor safety, utilization, operation and maintenance)
- ▶ The **Internet Reactor Laboratory (IRL) project** is another IAEA initiative to support nuclear capacity building which is presently under implementation in Latin America, Europe and Africa (PUI extra budgetary funds provided by the US DoS)
- ▶ Purpose is to create a **virtual access to an operating research reactor facility** connecting, through the internet, a **host reactor with students classes** taking place in guest institutions in other countries. **Practical experiments**, performed at the host reactor, **are broadcasted live to the guest institutions**, allowing students to interact with reactor operators and to have live experience of reactor behaviour during the experiment



# The IAEA Project on Research Reactor Nuclear Fuel Cycle

- ▶ The project assists Member States in **all aspects of research reactors fuel cycle**, including **development and qualification of new research reactor fuel, sustainable fuel supply, options for spent fuel management and development of LEU target designs for radioisotopes production**
- ▶ Specific areas of current work include support to Member States seeking **sustainable supplies of TRIGA reactor fuel; development of high-density U-Mo fuel (dispersed and monolithic)**; collaborative work to identify **viable spent fuel management options**, in particular for Member States hosting a research reactor but without a nuclear power programme
- ▶ Until today, the project has also contributed, upon Member States' requests, to international efforts to **minimize the civilian use of high enriched uranium (HEU)**

# The IAEA Project on Research Reactor Nuclear Fuel Cycle



## Ongoing CRPs are:

- “Benchmarks of Computational Tools against Experimental Data on Fuel Burnup and Material Activation for Utilization, Operation, Safety Analysis of Research Reactors”
- “Options and Technologies for Managing the Back End of the Research Reactor Nuclear Fuel Cycle”
- “Sharing & Developing Protocols to Further Minimize Radioactive Gaseous Releases to the Environment in the Manufacture of Medical Radioisotopes, as Good Manufacturing Practice”

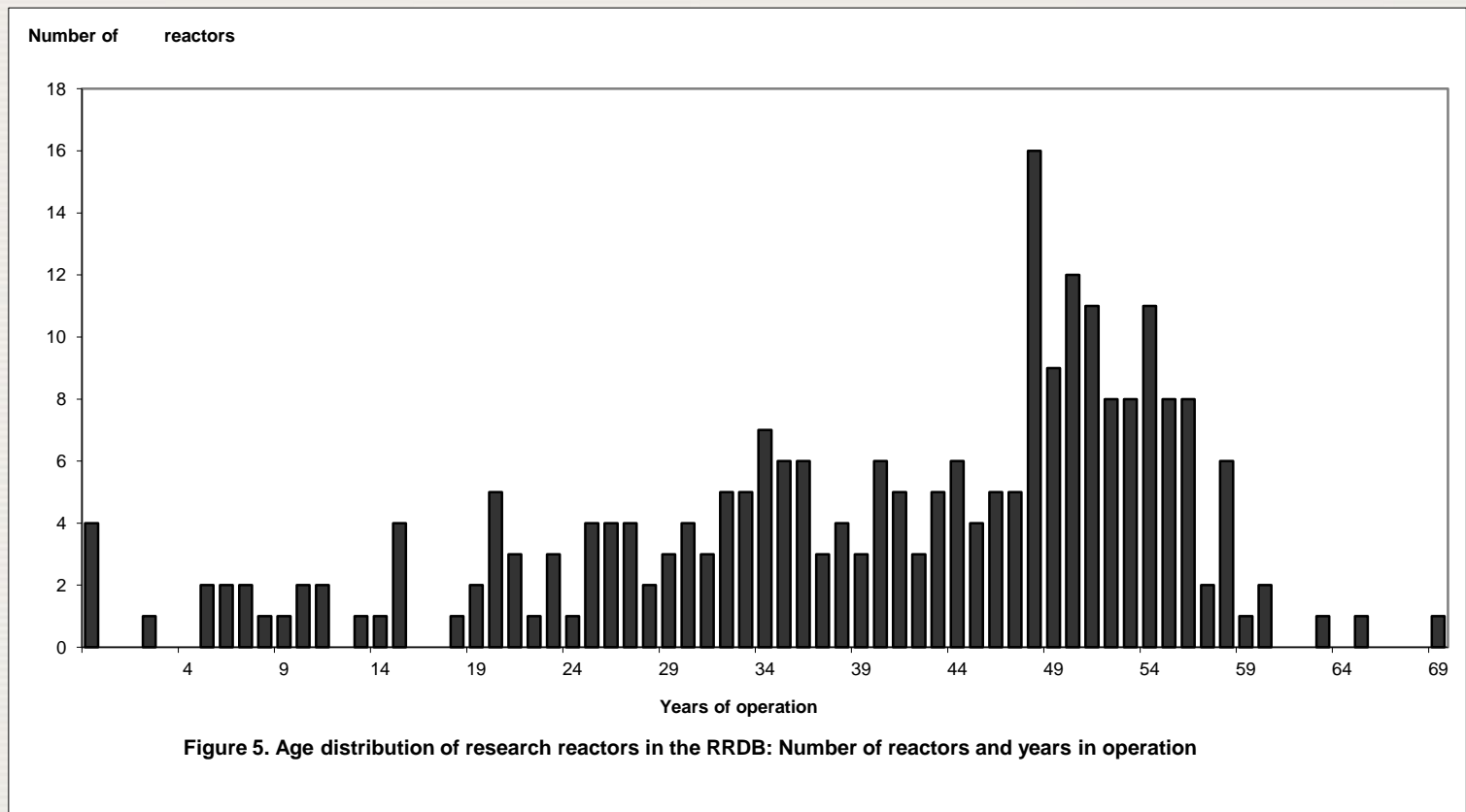


The project also **supports participation of Member States’ representatives in annual International Meetings** on Reduced Enrichment for Research and Test Reactors (**RERTR**) and Research Reactor Fuel Management (**RRFM**) conferences



# The IAEA Project on Research Reactor Operation and Maintenance

As per today, approximately **55%** of the research reactors are more than **40 years old** and **75%** have more than **30 years**



# The IAEA Project on Research Reactor Operation and Maintenance

- ▶ The Research Reactor Section works with Member States to **optimize research reactor availability and reliability through shared operating experience**, as well as the **development and implementation of operational and maintenance (O&M) plans, ageing management plans, training programmes and international peer reviews**
- ▶ The Operation and Maintenance Assessment for Research Reactors (**OMARR**) **mission is a peer review service, offered by the IAEA**, which aims to provide advice and assistance to Member States to improve their O&M practices, including the establishment or improvement of integrated management systems
- ▶ Request to the IAEA for advice, guidance and information exchange is also fulfilled by **documenting good practices and lessons learned as an element for strengthening operational management**

# The IAEA Project on Research Reactor Operation and Maintenance



## Ongoing CRPs are:

- 'Establishment of Material Properties Database for Irradiated Core Structural Components for Continued Safe Operation and Lifetime Extension of Ageing Research Reactors' (T34002)
- 'Condition Monitoring and Incipient Failure Detection of Rotating Equipment at Research Reactor' (T34003)

# The IAEA Commitment to Research Reactor Safety

- ▶ **IAEA Research Reactor Safety Section (RRSS) in the Department of Nuclear Safety and Security** supports Member States to enhance the safety of their research reactors
- ▶ A significant number of Member States are currently in different stages of new research reactor projects, of which the majority are building their first research reactor, which requires establishment of the **necessary safety components of the national infrastructure in accordance with the IAEA safety standards**
- ▶ The IAEA provides **assistance to address the identified safety issues and challenges, including support for capacity building** for establishing the necessary **regulatory, safety and technical components of the national infrastructure**

# The IAEA Commitment to Research Reactor Safety

- ▶ The RRSS supports Member States in the **effective application of the Code of Conduct on the Safety of Research Reactors** and the supporting **IAEA safety standards**
- ▶ **Regional strategies** are developed and supported by the IAEA for the **application of the Code**, which **facilitates mutual assistance** to solve safety issues and **enhance safety management and regulatory effectiveness**
- ▶ Assistance is also provided by means of training activities, **Safety Review Services**, and safety expert missions (**INSARR**) to solve specific safety issues
- ▶ Development of technical guidance through **coordinated research projects** also aims at improving the safety of research reactors
- ▶ Assistance is provided to Member States to **enhance their self-assessment capabilities** and to **improve regional networking** through the operation of the **Incident Reporting System for Research Reactors**

# The IAEA Commitment to Research Reactor Security

- ▶ The **IAEA Division of Nuclear Security** has enhanced activities in **support of national efforts to improve security of research reactors**. The objective of these activities is to **develop a comprehensive, focused and systematic approach to assist Member States to establish, enhance, and sustain security at research reactor facilities**
- ▶ The activities address security of research reactors in a systematic way, including: **state responsibilities, regulations, threat assessment, protection systems, response to nuclear security events, and physical protection upgrades**
- ▶ They also address **risk reduction by capacity building** to assist Member States with human resource development, **training materials** for nuclear security management and physical protection upgrades at research reactors facilities

# The IAEA Commitment to Research Reactor Security



**Advisory/peer review missions (e.g. International Physical Protection Advisory Service -IPPAS) and training courses** on Security Management for Research Reactor Operators are also offered to Member States together with **international guidance** based on Member States' experience and lessons learned



# Thanks for the Attention!

**International Conference on  
Research Reactors:  
Safe Management and Effective Utilization**  
16–20 November 2015, Vienna, Austria

