IAEA FACTSHEET

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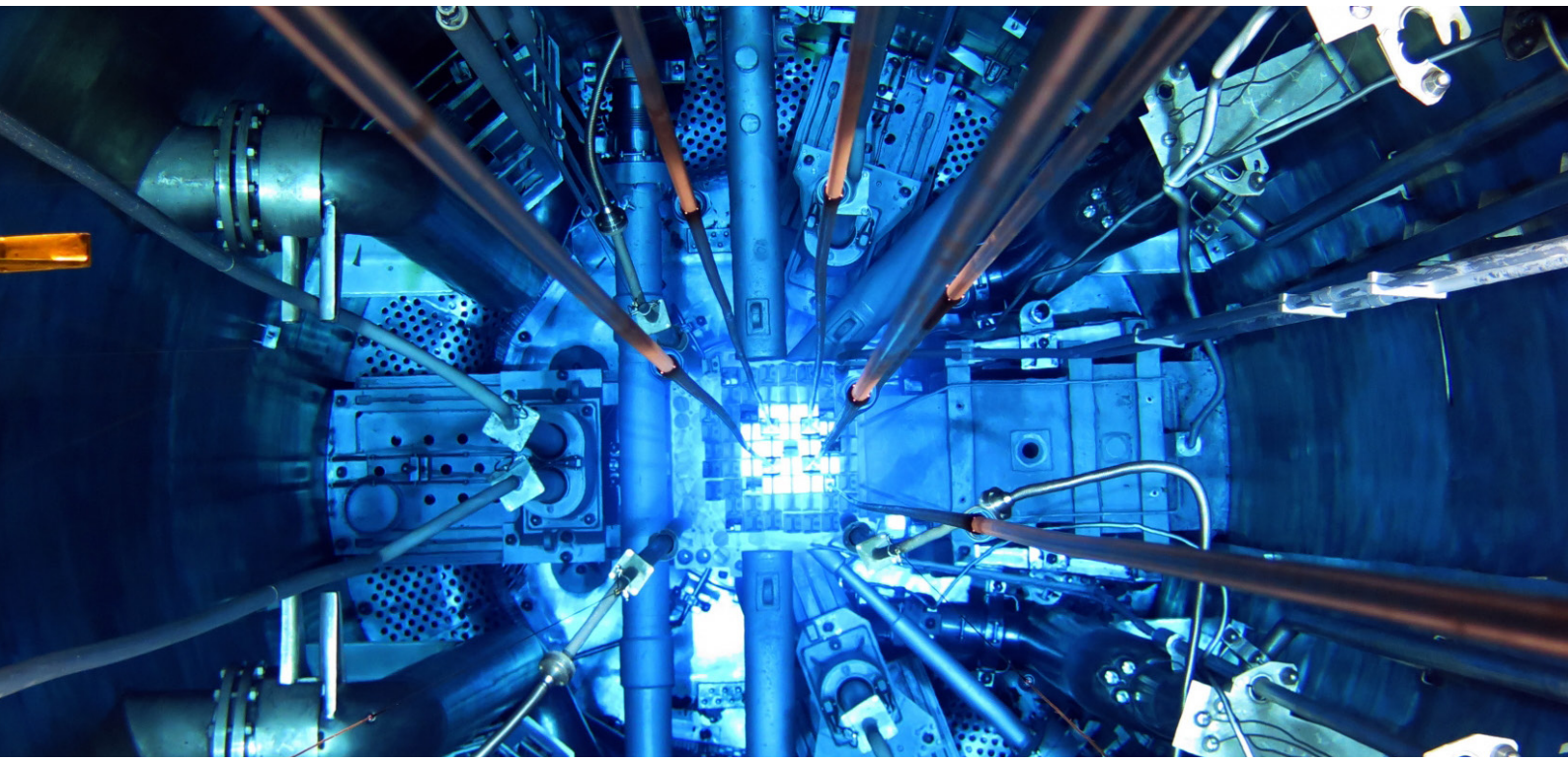
Nuclear Science & Technology

Supporting Science and Technology

The Role of Research Reactors



A peek into the Peru RP-10 research reactor.
(Photo: C. Brady/IAEA)

What should I know?

For more than 60 years, research reactors have been centres of innovation and productivity for nuclear science and technology. The multidisciplinary research supported by research reactors has spawned new developments in a diverse range of applications, such as neutron beam research for materials studies and non-destructive examination, neutron activation analysis to measure minute quantities of an element, radioisotope production for medical and industrial use, neutron irradiation for materials testing for fission and fusion reactors, neutron transmutation doping of silicon, and gemstone coloration.

Another important area to which research reactors make a positive contribution is education and training on nuclear science and technology for maintenance and operational staff of nuclear facilities, radiation protection personnel, regulatory and safety authority personnel, students, and researchers.

The IAEA assists its Member States in attaining the products and services that research reactors can provide, thus helping to fulfil the goal that nuclear science and technology offers for the good of humanity.

To date, some 841 research reactors have been built and, as of July 2019, 237 reactors in 54 countries were operating. More than half of the world's operational research reactors are now over 40 years old. Many of them are currently being refurbished to meet today's technological standards and safety requirements. At the same time, nearly 40 new research reactors are in different stages of planning or construction. The IAEA peer review service — Operation and Maintenance Assessment for Research Reactors (OMARR) — provides support for long term operation of such facilities with enhanced reliability and availability.

What types of research reactors exist?

Research reactors comprise a wide range of different reactor types. The primary use of research reactors is to provide a neutron source for research and various applications, as well as for education and training. They are smaller in size and generate less power than power reactors used to produce electricity. Research reactors exist with widely varying power ratings, from nearly zero to several hundred MW(th), as compared with 3000 MW(th) (1000 MW(e)) for a typical nuclear power plant (NPP).

There is a much wider array of designs in use for research reactors than for power reactors, and they also have different operating modes. Some of the common research reactor designs are:

1. Pool-type reactors, the core of which is a cluster of fuel elements immersed in a large open pool of water;
2. Tank-type reactors, the core of which is contained in a vessel; and
3. Tank-in-pool-type reactors, the core of which is located in a pool and also enclosed in a tank through which the coolant is pumped. More information on research reactor types can be found here: www.iaea.org/topics/research-reactors

Dissemination and preservation of knowledge

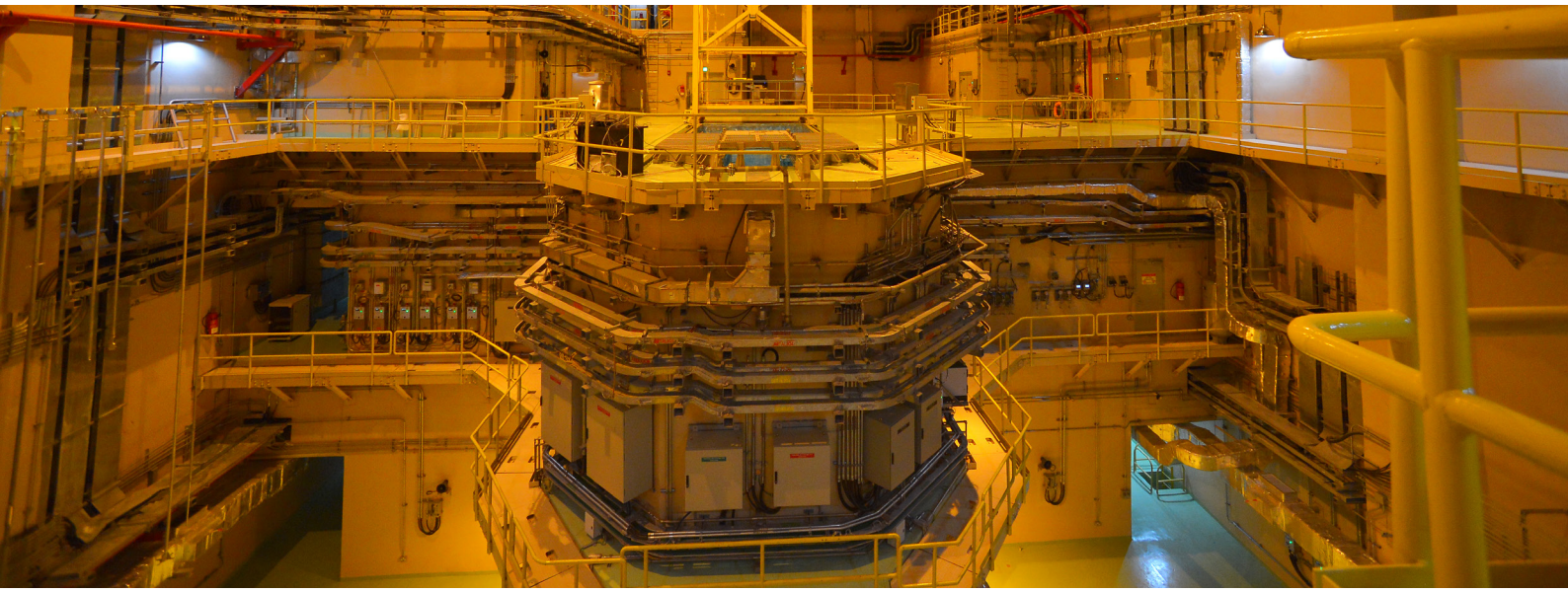
Research reactors have the potential to raise awareness of the advantages of nuclear technology for social development, including medical and industrial applications. Information about the uses of research reactors can be made available to researchers and students, as well as other interested stakeholders, such as members of the general public. Many research reactors have been built on university premises. Being located at academic institutions has enabled research reactors to contribute significantly to advancing nuclear education.

Widening support through capacity building

About 70% of operational research reactors are involved in education and training activities that support the development and use of nuclear technology. Since 2016, the IAEA has supported the Internet Reactor Laboratory, in which experiments conducted at a host research reactor in a Member State are broadcast to institutions in other Member States (that generally do not have a research reactor). This assistance enables remote access to such experiments for nuclear physics and nuclear engineering students. The IAEA has also developed and made available to Member States e-learning modules on different subjects related to research reactors, including safety, operation and utilization.

Since 2009, the IAEA has been offering group fellowship training (GFT) courses to assist Member States that are considering building research reactors as a first step to developing their nuclear competence and infrastructure. GFT courses help participants to develop the skills and gain the practical experience necessary to carry out activities related to the entire life cycle of research reactors, from design, construction and operation, through to decommissioning.

The GFT programme has been organized and successfully implemented within the framework of the Eastern European Research Reactor Initiative



Jordan's research and training reactor hall, which is inside the reactor building where the facility is located.
(Photo: D. Calma/IAEA)

(EERRI) with support from institutions from Austria, Czech Republic, Hungary and Slovenia. In addition, regional research reactor schools have been organized to provide training with hands-on experience and the International Centres of Excellence Based on Research Reactors (ICERRs) provide advanced training to the professionals from nuclear field.

The IAEA's objectives

The IAEA's programme of activities includes supporting Member States in the promotion, development and maintenance of dynamic, safe and secure research reactors dedicated to peaceful uses of nuclear energy and nuclear techniques for the benefit of the nuclear industry and the well-being of humanity.

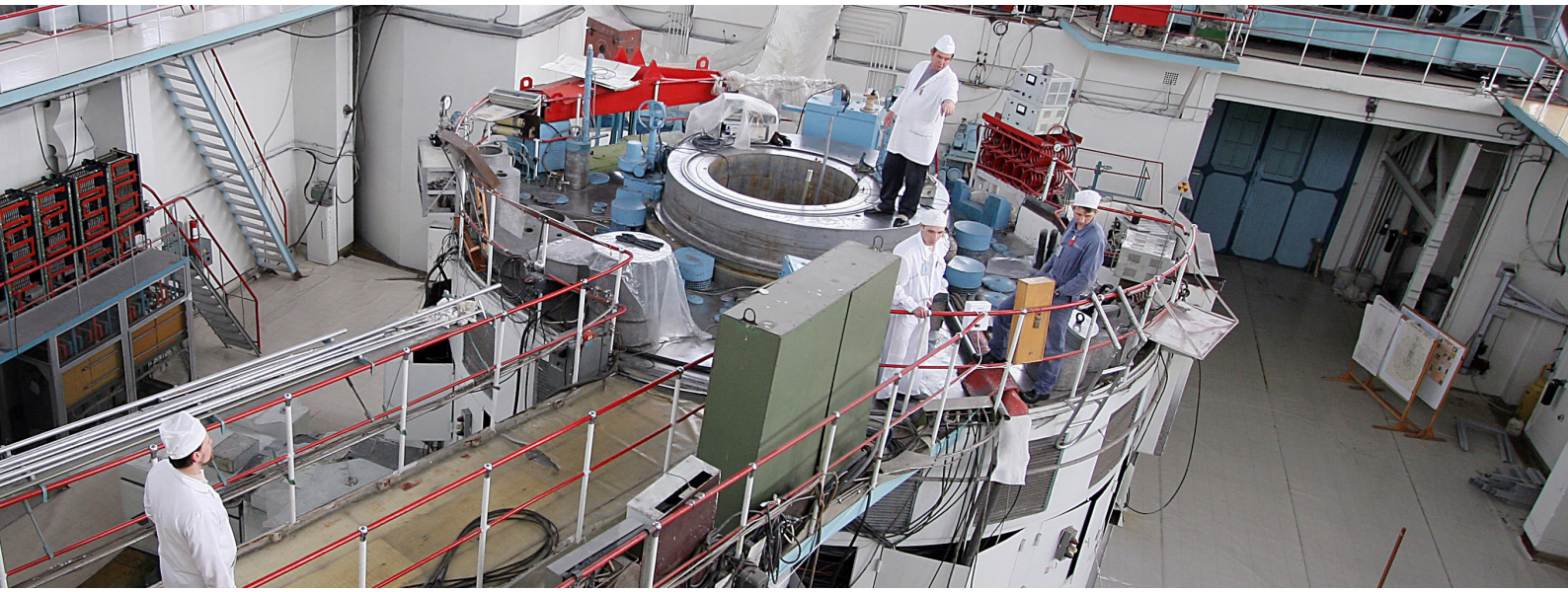
Member States considering a new research reactor programme can approach the IAEA for guidance and assistance in building the necessary national nuclear infrastructure and can request an Integrated Nuclear Infrastructure Review for Research Reactor (INIR-RR).

The IAEA's priorities

The IAEA supports international networks of research reactors in its Member States in order to ensure that these reactors are better utilized, modernized, more sustainable, safer and more secure.

The IAEA supports Member States in:

1. Addressing safety and security challenges for research reactors and associated fuel cycle facilities, and assisting in the decommissioning of shutdown reactors with the appropriate political and financial commitment by the national government and/or industry;
2. Assisting in the establishment of new research reactor programmes, including the necessary national nuclear infrastructure;
3. Assisting in addressing issues related to the fuel cycle and the minimization of civilian use of high enriched uranium;
4. Enhancing the reliability, availability and utilization of operating facilities in line with their capabilities and objectives, provided there is financial commitment by the national government and/or industry; and
5. Helping to share research reactor resources and assisting in the development of state-of-the-art facilities, thereby helping socioeconomic development.



The Alatau research reactor, Kazakhstan.
(Photo: P. Chakrov/Institute of Nuclear Physics)

Furthermore, through strategic planning and support from stakeholders, the IAEA assists Member States to become part of research reactor partnerships and networks to improve all aspects of the utilization, modernization and sustainability of existing research reactors.

Countries without research reactors are encouraged to join these networks as a first step in developing their national capabilities, either as a partner or as an end user of research reactor products and services.

Safety at research reactors

Through its programmes and activities, the IAEA assists Member States in enhancing the safety of research reactor facilities. This includes supporting Member States in the effective application of the IAEA Code of Conduct on the Safety of Research Reactors and the IAEA safety standards, and to build capacity for safety of research reactors throughout the lifetime of these facilities.

Upon the request of Member States, the IAEA conducts advisory and peer review missions, such as the Integrated Safety Assessment of Research Reactors (INSARR), to assist in enhancing the safety of these facilities, including the safety of utilization programmes and operational safety performance.

Global status

The IAEA's Research Reactor Database (RRDB) lists several categories of research reactors. The Russian Federation has the highest number (54) of operational research reactors, followed by the USA (50), China (16), Japan (9), Germany (7), Argentina (6), Canada (5), France (5) and India (5). Many developing countries also have research reactors, including Algeria, Bangladesh, Colombia, Ghana, Jamaica, Libya, Morocco, Nigeria, Thailand and Viet Nam. Other Member States are building or planning to build their first research reactors.

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