



60 Years

IAEA

Atoms for Peace and Development

IAEA Activities to Support Sustainable Operation of and Access to Research Reactors

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Environmental Scan

- Research reactors (RRs) have contributed for more than six decades and continue contributing to the advances in nuclear science and technology development in IAEA Member States (MS), including nuclear power
- The **sustainability of their life-cycle** is an issue of major relevance and MS are increasingly seeking Agency's assistance in addressing the main challenges related to RR sustainable operation, including effective utilization, as well as in building new and accessing existing RRs for developing their national nuclear programmes and strategies, including human capital development
- Research reactors remain **indispensable tools** for the provision of radioisotopes for medicine and industry, neutron beams for material/fuel research and non-destructive testing, analytical and irradiation services, calculation codes validation and nuclear data measurements, both for and cultural heritage and environmental studies

Environmental Scan

- Equally, the contribution of RRs to the **education and training** of the new generation of scientists and engineers in support of nuclear science and technology programmes remains a strategic role for their utilization
- As the RR fleet is decreasing (in developed countries), the remaining and new facilities need to be efficiently utilized, well managed and aim for sustainable operations
- Life of research reactors can reach 60 years and beyond but it is of paramount importance that **adequate life management programmes** (ageing management, refurbishment, and modernization programmes) are established timely

Environmental Scan

- Adequate operation and maintenance (O&M) plans, as well as management system, need also to be in place to ensure optimization of operational performances of existing research reactors
- Considering the general trend of **funding reduction** for such facilities and **limited succession planning**, development and implementation of sound O&M as well as life management programmes are vital to ensure for these facilities a cost-effective completion of their assigned missions
- Another very relevant issue is related to the fact that more than **one hundred research reactors are currently in permanent shut-down state** and need to be decommissioned

Environmental Scan

- **Assurance of fresh fuel supply** is a concern for RRs and cooperation between RR operating organizations and MS can be fostered by the Agency to leverage supply options
- In this framework, ongoing international programmes seek to **convert RR fuel** (and **targets** for the production of radioisotopes) from High Enriched Uranium (HEU) to Low Enriched Uranium (LEU)
- Many RRs have been converted to LEU fuel, with significant quantities of fresh and spent HEU repatriated to the country of origin. Other conversions are planned with existing qualified fuels but **development and qualification of high density fuels are necessary** to convert high performance RRs

Environmental Scan

- A relevant concern is posed by the **back-end options for the RR nuclear fuel cycle** which needs to comply with non-proliferation, national policy, economics, and environmental requirements and constraints as well as with technical issues
- The continued **safe, reliable and economic management and storage of RR Spent Nuclear Fuel (SNF)** of all types is a serious issue for most MS with RRs, also considering that most RR SNF is aluminium clad currently in wet storage, and is therefore particularly vulnerable to corrosion
- Many countries with one or more RR and no nuclear power programme face the problem of **final disposition for relatively small amounts of SNF** or they may be **forced to permanently shut down their RRs** before the termination of the RR SNF take-back international programmes

Environmental Scan

- Several MS have **started planning or building their first research reactor** as a key national facility for the development of their nuclear science and technology programmes, including nuclear power
- However, the introduction of the first research reactor in a country requires the **establishment of an adequate national infrastructure** which covers a wide range of technical areas to ensure that national and international commitments and obligations, particularly regarding **safety, security, safeguards and nuclear liability**, are met during the construction, operation and decommissioning phases

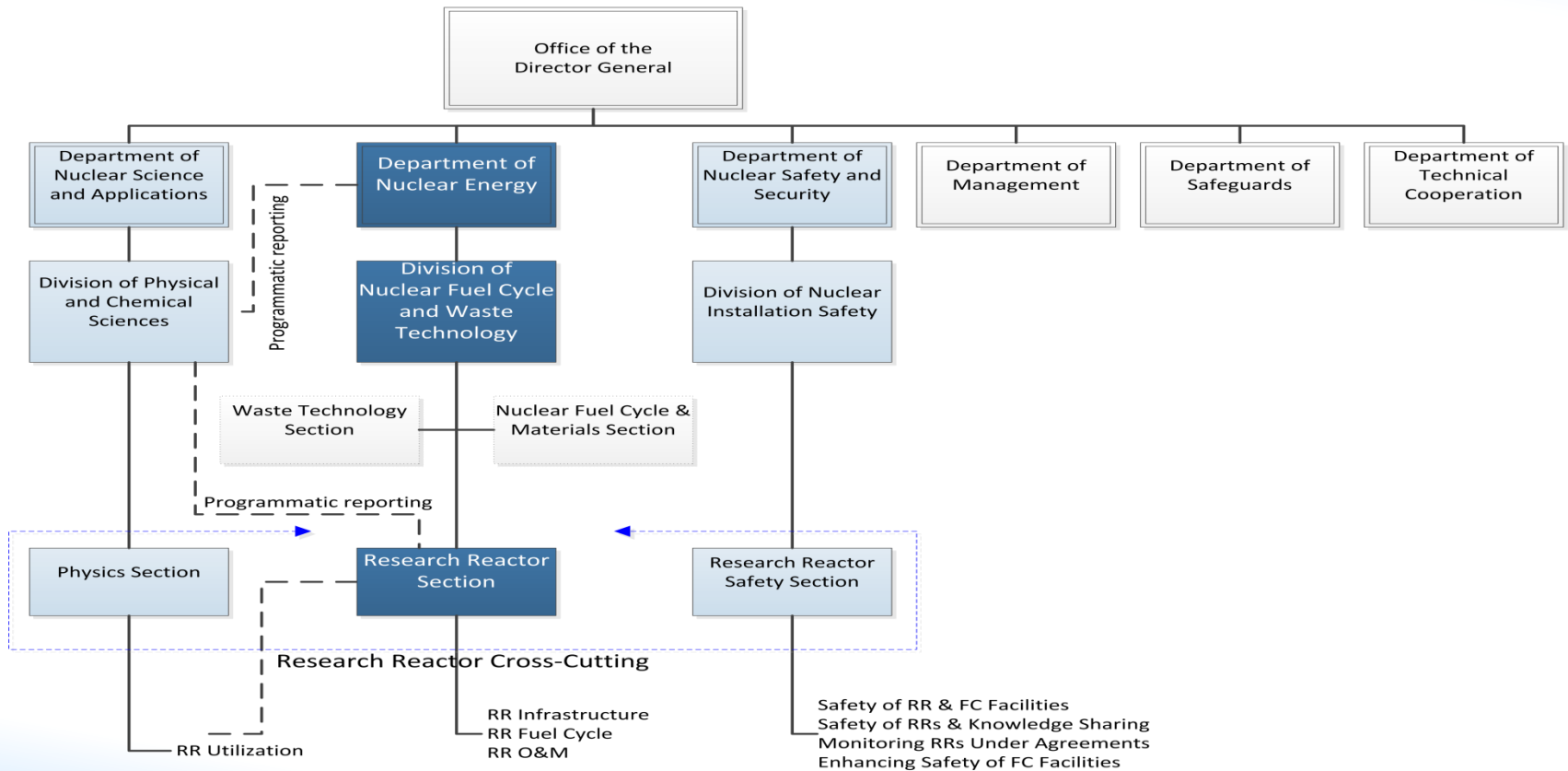
Environmental Scan

- Besides, these MS typically need to **develop national competencies as well as a framework of research and development (R&D) strategies** to effectively support the implementation or expansion of their nuclear programmes
- To achieve these goals, they often require **access to research reactors (RRs) and their ancillary facilities** (e.g. hot laboratories) to educate and train the young generation of nuclear scientists, engineers, and technicians and to conduct nuclear R&D projects
- World-wide there are RR operating organizations that have established nuclear capacity building and R&D programmes but, often, access to such nuclear infrastructure can be challenging for a single MS

RR sub-programme (1.4.2.)

- The **IAEA sub-programme on Research Reactors** has the following objectives:
 - To support Member States in enhancing sustainable operation and effective utilization of existing research reactors
 - To support Member States in planning and implementing new research reactor projects, including the development of their national infrastructure
 - To support Member States in nuclear capacity building based on the use of and access to RRs
- It is important to note that achieving and maintaining adequate level of nuclear safety is essential to ensure sustainable operation, including effective utilization, of research reactor facilities
- Continued safe operation of research reactors is also essential to their future, future of nuclear power, and the future of the whole community
- Almost all issues and challenges for research reactor sustainable operation involve nuclear safety components, and therefore effective coordination between IAEA organizational units having programmes or activities on research reactors is necessary to maximize the benefits to MSs

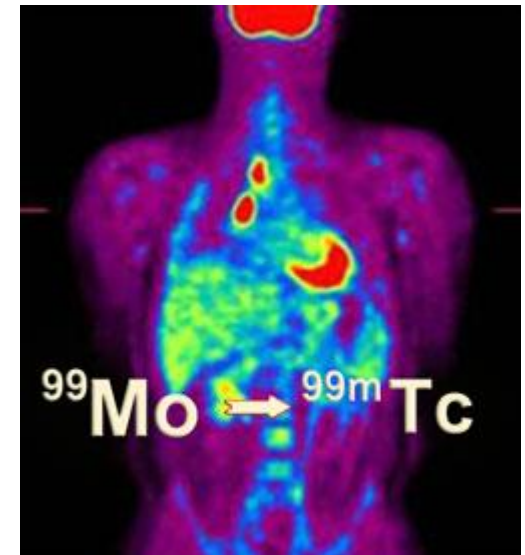
Cross-cutting Activity on RRs Coordination Group



Project 1.4.2.001

Enhancement of utilization and applications of research reactors

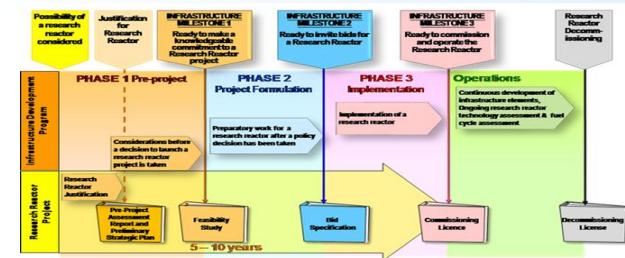
- Through provision of specific guidance, topical meetings, training courses, expert missions and peer review missions, assistance is provided to MS operating RRs to **enhance their capability for provision of products and services** such as: radioisotope production, use of neutron beams, irradiation and analytical services, material characterization and testing consistent with their RR features, nuclear education and training
- At the same time, assistance is provided in **developing strategic and business planning** as well as for improving capability in **stakeholders' involvement** and **market analyses** for the goods and services that can or could be provided by their facilities
- The strategy to enhance the utilization of the operating RRs also includes **support for cooperation and resource sharing** among different RR facilities and promotion and strengthening of both regional and thematic networking, including interested Member States without RRs



Project 1.4.2.002

Research reactor infrastructure, planning, and capacity building

- Member States which have embarked or are embarking on new RR projects are assisted through specific guidance, topical meetings, training courses, expert missions and peer review missions (**INIR-RR mission**) developed and conducted in the framework of the **IAEA-developed Research Reactor Milestones Approach**
- Support and guidance for **self-assessment of MS' national nuclear infrastructure** during different phases of their project, is also provided to ensure that it is adequately and timely developed
- Member States **building and/or preserving national nuclear capacity**, including human capital development, for their science and technology programmes, including nuclear power programmes, can benefit from the **use of or access to existing RRs**
- The strategy to offer such MS the opportunity to build capacity through RRs is based on a **4-levels scheme** which comprises: a distance learning tool, mainly for academic education (**Internet Reactor Laboratory**), use of RRs for basic professional hands-on training (**Research Reactor Regional Schools and EERRI Course**) and access to World state-of-the-art facilities for advance professional training (**ICERR Scheme**)



Project 1.4.2.003

Addressing research reactor fuel cycle issues

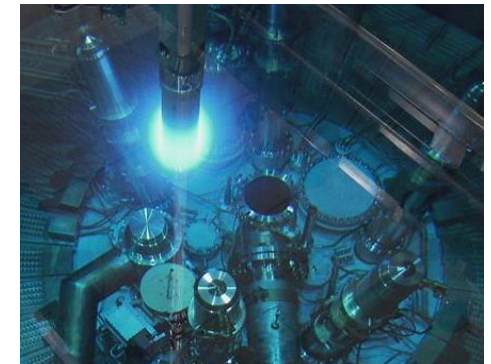
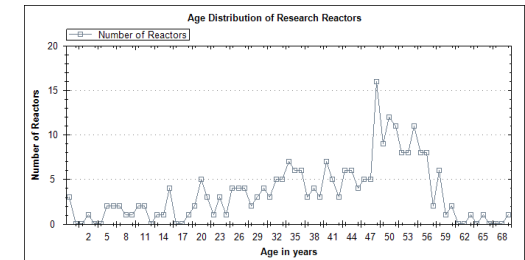
- For strengthening MS capability to deal with all fuel cycle issues, including **fresh fuel supply, development, fabrication and qualification of new fuels, vulnerabilities related to SNF management and the back end of the fuel cycle**, specific guidance, topical meetings and expert missions are provided
- Upon request, assistance with **the conversion of RR fuels and targets for radioisotope production from HEU to LEU and repatriation of SNF to its country of origin** is provided through dedicated projects characterized by substantial in-field activities



Project 1.4.2.004

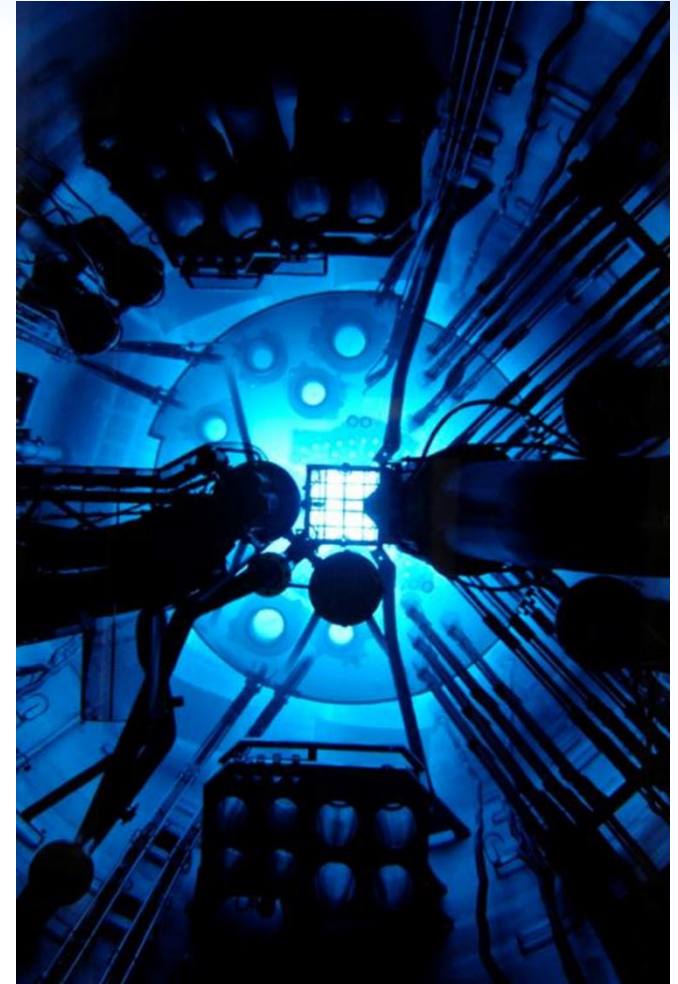
Research reactor operation and maintenance

- Support to MS seeking assistance to **improve the operational performances** of their facilities and to **address the long-term operation issues**, is provided through specific guidance, topical meetings, training courses, expert missions and peer review services (OMARR mission) focussed on
 - developing and implementing operation and maintenance plans
 - establishing an integrated management system
 - developing and implementing ageing management and refurbishment and modernization programmes
- Enhanced **access to information** on material properties degradation and structures, systems and components (SSC) failure mechanisms under operational conditions as well as dissemination of good practices and lessons learned in addressing aging issues is also part of the strategy to support sustainable long-term operation of RRs.



Four Tools for Capacity Building

- The IAEA has recently developed a specific scheme of services for **Nuclear Capacity Building in support of the Member States**
 - operating research reactors (RR)
 - willing to use RRs as a primary facility to develop nuclear competences
 - as a supporting step to embark into a national nuclear programme.
- The scheme is composed of **four complementary instruments**, each of them being targeted to specific objective and audience
 - **Distance Training:** Internet Reactor Laboratory (IRL)
 - **Basic Training:** Regional Research Reactor Schools
 - **Intermediate Training:** East European Research Reactor Initiative (EERRI) Group Fellowship Course
 - **Advanced Training:** International Centres based on Research Reactors (ICERR)



Distance Training: Internet Reactor Laboratory

Objective

Connects through internet an operating research reactor (Host reactor) to Guest institutions, generally Universities within the same region

Offers the opportunity to **add a practical component to academic programmes** in nuclear engineering, and nuclear physics, when access to an operating research reactor in the country is not feasible

Programme

5 or 6 half day sessions broadcasted every year to Guest institutions (criticality exp., rod calibration, temperature effect, ...)

Participants

Mainly intended for students of nuclear engineering and nuclear physics; **can also be extended to other audiences**, such as nuclear professionals, offering tailored experiments or demonstration exercises



Basic Training: Regional Research Reactor Schools



Objective

Offers a **unique on-site hands-on training experience** taking advantage of practical research reactor experiments generally conducted at different research reactors within the same region

Programme

A **two week course** on reactor physics, safe operation and utilization, combining **theoretical classes (50 %)** and **hands-on exercises (50 %)**

Participants

Intended for **young professionals** with a technical degree in nuclear engineering, nuclear physics or related fields; their current or future assignment is generally **linked to existing research reactor facilities or reactors in advanced planning stage**



Intermediate Training: EERRI Group Fellowship Course

Objective

A **more extensive learning opportunity**, including theoretical classes, facilities familiarization, and hands-on experimental activities

Programme

It involves **theoretical classes, site visits and extensive hands-on experimental activities**

It covers a **broad range of topics** related to RRs, as well as nuclear safety, security and safeguards considerations, radiation protection and an introduction to nuclear power plants

Candidates are periodically tested and evaluated; they receive an attendance certificate.

Participants

Intended for **young professionals** with degrees in engineering and science and preferably with some experience in the nuclear field; participants' current or future assignment is generally **linked to a national research reactor or nuclear power programme**



Advanced training at ICERRs

Objective

The ICERR scheme is intended to help MSs **gain timely access to relevant infrastructure based on RR and ancillary facilities** to achieve both their nuclear R&D and Capacity Building objectives

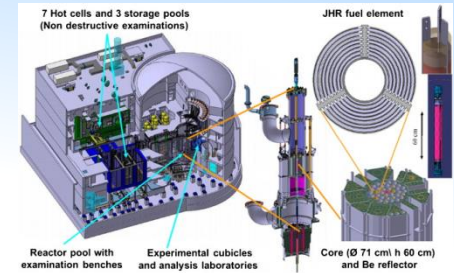
Access to an ICERR is carried out through a **bilateral agreement** signed between a MS's Organization (named Affiliate) and the ICERR (**IAEA acts as a facilitator**)

Programmes

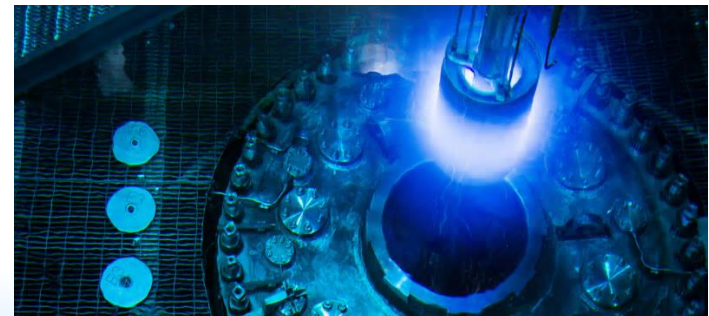
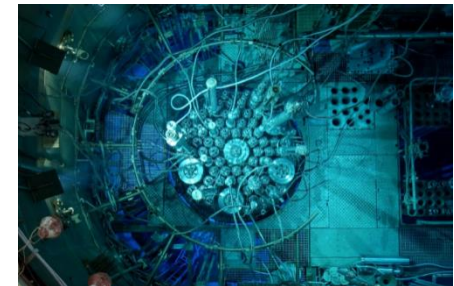
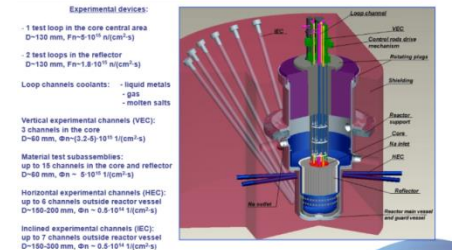
ICERRs can exhibit a **broad spectrum of offers related to nuclear capacity building** such as **education and specific training for young professionals**, specific **hands-on-training program** (e.g. irradiation and testing services or hot or analytical laboratories); **on-the-job training** for research reactor operators, maintenance personnel, radioprotection specialists or regulators

Participants

Particularly well suited for **professionals with experience** in research reactor operation, maintenance and utilization; **it can also be used for initial education and training**



MBIR design and experimental capabilities

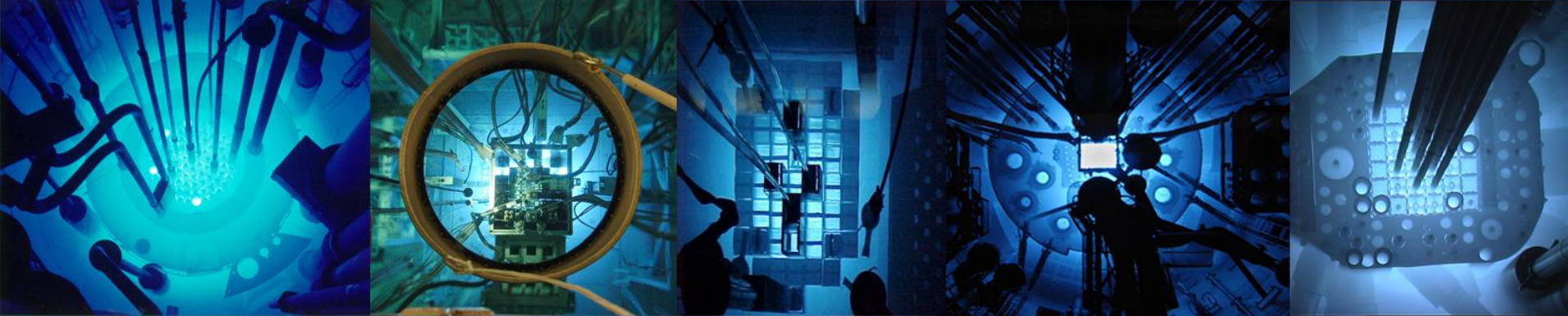




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Thank you!