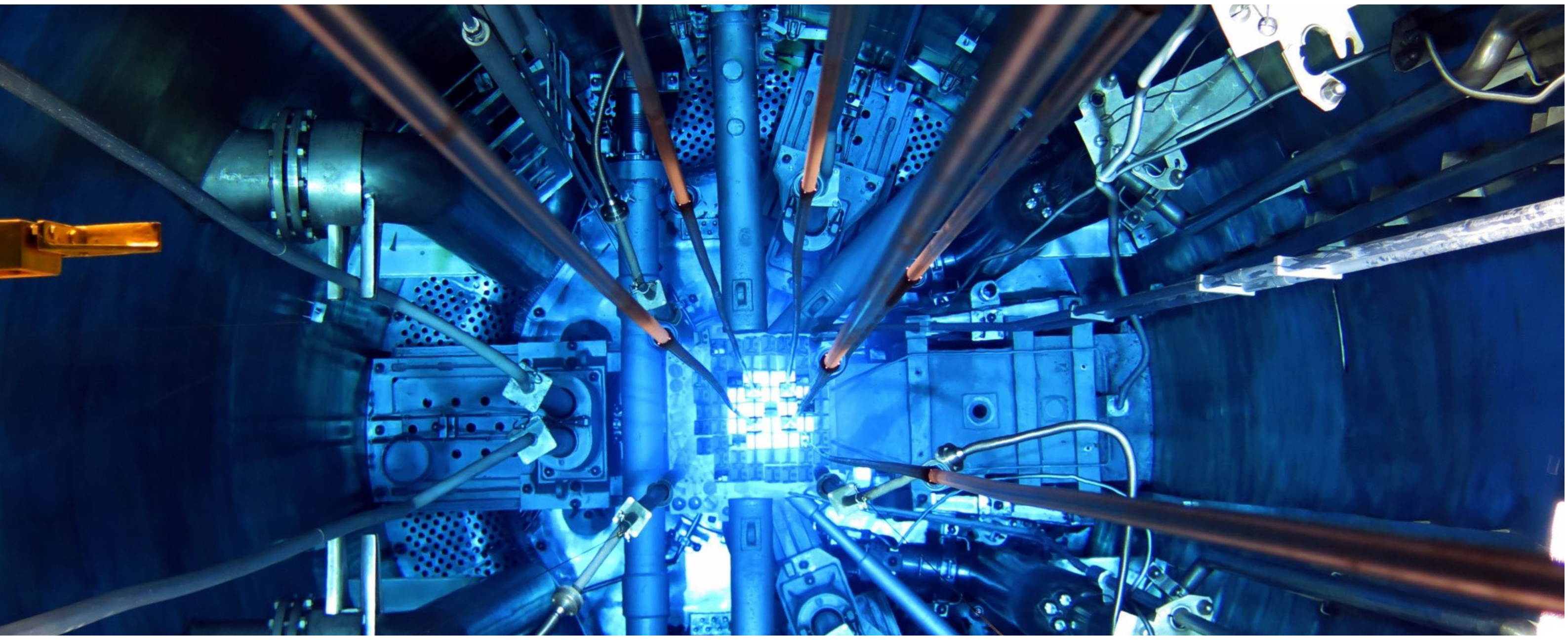
Nuclear infrastructure development to reap the benefits of research reactors

By Matt Fisher



A research reactor core.
(Photo: IAEA)

Research reactors can be used for a variety of purposes, from training nuclear engineers and conducting scientific research, to producing radioisotopes and developing advanced materials. But before a country can embark on a new research reactor project, it must first have in place the proper infrastructure.

"The IAEA provides guidance on issues in establishing and implementing research reactor projects. These include legal and regulatory frameworks, human resource development, safeguards, safety and security, among others," said Andrey Sitnikov, Technical Lead for research reactor nuclear infrastructure and capacity building at the IAEA. "The IAEA's Milestones approach helps countries effectively and holistically develop their research reactor programmes so they can safely and reliably utilize their research reactors."

Milestones approach

The Milestones approach is a comprehensive scheme divided into three phases that lay out what a country must accomplish in 19 areas of infrastructure development, including nuclear safety, human resources, financing and management. It can be used both for nuclear power programmes and research reactor programmes.

While the general contours of the approach are largely similar for research reactor programmes and nuclear power programmes, the main distinction is related to the level of utilization: research reactors have a wide range of applications, whereas nuclear power reactors are primarily used to generate electricity. This means that when a country uses the Milestones approach for research reactors, it must first determine what the research reactor will be used for. Knowing the research reactor's purpose is essential not only to identify the specific infrastructure elements required, such as the types of specialists to hire and facilities to build, but also to effectively apply the Milestones approach.

Three main phases of development

The research reactor development process is organized into three main phases: preparing a feasibility report to justify the need for a research reactor project; setting up for construction of the reactor, including the establishment of legal and regulatory frameworks; and constructing and commissioning the new reactor.

Each phase has a completion marker, or ‘milestone’, to help a country track its progress and assess its preparedness before beginning work on the next phase. Milestone 1 is achieved when a country is ready to commit to a research reactor programme; Milestone 2 is completed when a country is ready to begin negotiating a contract for the construction and operation of the reactor; and Milestone 3 is attained when the reactor is ready to be commissioned.

Review and improve

Assessing what infrastructure already exists and what still needs to be further developed is an important step in establishing or expanding a research reactor programme. The IAEA helps countries, upon request, review their status and determine areas that may need improvement through Integrated Nuclear Infrastructure Review for Research Reactors (INIR-RR) missions. These are IAEA-coordinated peer review missions, which are holistic in nature and are conducted by international teams made up of both IAEA and external experts who have direct experience in specialized research reactor nuclear infrastructure.

Before a mission, the interested country will first complete a self-evaluation report on the 19 infrastructure issues according to the IAEA’s publication Specific Considerations and Milestones for a Research Reactor Project. Experts then assess the situation based on evidence, including strategic plans and site considerations, gathered during the INIR-RR mission.

After the mission is concluded, the INIR-RR team prepares a report with recommendations on action items to be implemented. A follow-up mission may take place approximately two years after the initial mission in order to assess the implementation status of the recommendations. An action plan to provide targeted capacity building on some of the 19 infrastructure issues, taking into account the review findings, is usually put in place between the country and the IAEA.

First ever INIR-RR mission

The first ever INIR-RR mission took place in Nigeria in February 2018. Nigeria has a 30 kW(th) miniature neutron source research reactor (MNSR), which has been in operation since 2004 and is used for training activities and neutron activation analysis but cannot be used for other applications.

The country’s authorities envisage a larger, more versatile multipurpose research reactor (MPR) for applications including the production of radioisotopes for both cancer care and food preservation. The MPR would also serve to scale up experience in operating larger reactors and assist the country on its journey towards a potential nuclear power programme in the future.

As Nigeria already has a research reactor programme, most of the infrastructure requirements for the MPR have already been addressed to a certain extent; however, operating a larger research reactor requires further strengthening and building on the existing infrastructure. The recommendations made by the INIR-RR mission team emphasized increasing the focus on human resource development. Nigeria plans to commission the reactor by 2025.

Expansion to achieve more

An MPR is also part of Viet Nam’s plans to expand its programme to broaden the scope of what the country can achieve with research reactors. Viet Nam currently operates a relatively small research reactor — a 500 kW(th) pool-type reactor — for a variety of applications, including limited radioisotope production and neutron beam research and development.

An INIR-RR mission to Viet Nam was conducted in December 2018. The mission team concluded that Viet Nam had made significant progress towards establishing the infrastructure necessary for an MPR. Recommendations included conducting a more detailed utilization assessment for the MPR and bolstering the independence of the regulatory body.

“The planned 10–15 MW(th) research reactor will enhance our capacity in scientific research, education and training, and radioisotope production,” said Hoang Anh Tuan, Director General of the Viet Nam Atomic Energy Agency. Viet Nam plans to commission the MPR by 2026. “The INIR-RR mission has helped us identify areas for further infrastructure development, including our radioactive waste management strategy and our regulatory framework.”

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