Nuclear Fuel Cycle and Waste Management

Objective

To support Member States in establishing effective, safe, secure and sustainable frameworks and solutions for the fuel cycle, radioactive waste management, decommissioning and life cycle management of related facilities, including research reactors, for nuclear programmes and nuclear applications. To support Member States in strengthening their capabilities and human resources in the domains of fuel cycle, radioactive waste management, decommissioning and environmental remediation, and research reactors. To be a platform to facilitate and strengthen international cooperation, coordination and information sharing among Member States.

Uranium Resources and Processing

Participants in the Technical Meeting to Collect and Document Innovations in the Uranium Production Cycle, held virtually, shared information and discussed technical innovations to make future low grade uranium deposits economically, technically and socially feasible.

Nuclear Power Reactor Fuel

The publication *Fuel Failure in Normal Operation of Water Reactors: Experience, Causes and Mitigation* (IAEA-TECDOC-2004) provides an up-to-date review of data, experience and knowledge in the area of fuel failure during the operation of water cooled reactors.

Agency publications *Fuel Modelling in Accident Conditions (FUMAC)* (IAEA-TECDOC-1889) and *Analysis of Options and Experimental Examination of Fuels for Water Cooled Reactors with Increased Accident Tolerance (ACTOF)* (IAEA-TECDOC-1921) were translated into Arabic, Chinese and Russian.

The publication *Near Term and Promising Long Term Options for the Deployment of Thorium Based Nuclear Energy* (IAEA-TECDOC-2009) summarizes the results of a CRP on the topic. In particular, it presents the enhanced capabilities of thorium based fuels for high conversion ratio fuel cycles, improved inherent safety characteristics, and reduced minor actinide production.

Participants in the Technical Meeting on the Structural Behaviour of Fuel Assemblies in Water Cooled Reactors, held virtually, exchanged information on fuel design and operation, experimental data assessment, fluid–structure interactions, retrievability of used fuels, licensing aspects and regulatory acceptance.

Management of Spent Fuel from Nuclear Power Reactors

Participants in the Technical Meeting to Identify Opportunities and Challenges in the Back End of the Fuel Cycle for Evolutionary Accident Tolerant Fuels, held virtually, developed a working definition

of such fuels and discussed the work under way to understand their impact on back end activities and to identify key questions and information needed.

Participants in the Technical Meeting on Back End of the Fuel Cycle Considerations for Small Modular Reactors identified the opportunities and challenges faced at all stages of the back end of the fuel cycle, the gaps in current infrastructure and the potential ways to move forward in addressing them in the near, medium and long term.

Radioactive Waste Management

The publication *Experience in the Management of Radioactive Waste After Nuclear Accidents: A Basis for Preplanning* (IAEA Nuclear Energy Series No. NW-T-1.31) summarizes experiences and preparedness for managing waste in the event of a nuclear or radiological accident. The publication *Communication and Stakeholder Involvement in Radioactive Waste Disposal* (IAEA Nuclear Energy Series No. NW-T-1.16) provides practical guidance on the subject for countries embarking on, relaunching or revising a disposal programme.

Professional networks on predisposal and disposal were convened with a Technical Meeting organized for each network. The International Low Level Waste Disposal Network (DISPONET) meeting in Bulgaria focused on the closure of near surface disposal facilities, emphasizing the design and studies of the closure system at the beginning of the planning and construction phase.

Participants in the DISPONET meeting visited the national repository under construction at the Radiana site, Bulgaria.

Management of disused sealed radioactive sources

The Agency published *Management of Disused Radioactive Lightning Conductors and Their Associated Radioactive Sources* (IAEA Nuclear Energy Series No. NW-T-1.15) highlighting aspects related to the recovery and dismantling of radioactive lightning conductors. The report *Management of Disused Sealed Radioactive Sources* (IAEA Nuclear Energy Series No. NW-T-1.3) was published and translated into Russian. In 2022, disused sealed radioactive source (DSRS) management support was rendered in Cambodia, Chile, the Congo, Greece, Jordan and Nepal.

Through the Technical Meeting on National and International Experiences in the Reuse and Recycling of Disused Sealed Radioactive Sources, practical strategies to deal with disused capsules were shared and contacts between potential DSRS donors and recipients were established.

Decommissioning and Environmental Remediation

Decommissioning

The Agency's Workshop on Characterization and Monitoring to Support the Management of Radioactively Contaminated Land enabled the sharing of good practices and experience related to characterization methodologies and technologies.

The publication *Decommissioning at a Multifacility Site: An Integrated Approach* (IAEA Nuclear Energy Series No. NW-T-2.13) provides practical guidance and examples of good practices in nuclear decommissioning. The Agency published *Training and Human Resource Considerations for Nuclear Facility Decommissioning* (IAEA Nuclear Energy Series No. NG-T-2.3 (Rev. 1)), which provides methodological guidance for, and specific examples of, good practices in training as an integral part of human resource management for staff performing decommissioning activities.

The Technical Meeting on Human Resource Development for Decommissioning enabled information to be shared and recent practices to be discussed, including issues of recruitment, motivation and retention. The Technical Meeting on the Use of E-Tools for Competence Building in Decommissioning and Environmental Remediation comprised detailed discussions and exchanges on current good practices and challenges in the use of digital technologies to promote competence development.

The International Workshop on Lessons Learned from the Implementation of Decommissioning Projects for Water Cooled, Water Moderated Power Reactors (WWERs), hosted by the Nuclear and Decommissioning Company (JAVYS) in Slovakia and supported by the European Commission and European Bank for Reconstruction and Development, allowed recent developments in WWER decommissioning projects in a preparatory phase and in progress to be shared and discussed.

The Technical Meeting on Preparation for Decommissioning for Research Reactors, the Technical Meeting on Ensuring Operator Preparedness for the Transition from Operation to Decommissioning and the International Workshop on Managing the Transition from Operation to Decommissioning, all held in Vienna, addressed all relevant aspects of preparation for decommissioning.

Environmental remediation

The Agency organized the Biennial Forum of the Network on Environmental Management and Remediation, providing for the exchange of recent experiences and practices within remediation projects. The Workshop on Characterization and Monitoring to Support the Management of Radioactively Contaminated Land and a series of meetings on the management of naturally occurring radioactive material supported decision making and highlighted added value in transforming remediation liabilities into assets.

Research Reactors

Utilization and applications of research reactors

A new CRP on Development of Neutronic and Thermal-Hydraulic Coupled Calculational Methodologies for Research Reactors Including Treatment of Uncertainties was launched to increase the knowledge and expertise of Member States in numerical analysis and to improve the design, operation, utilization and safety of research reactors.

The publication *Quality Assurance and Quality Control in Neutron Activation Analysis: A Guide to Practical Approaches* (Technical Reports Series No. 487) provides practical guidance on quality assurance and quality control in neutron activation analysis laboratories.

The consolidated results of a closed CRP were published as *Benchmarks of Fuel Burnup and Material Activation Computational Tools Against Experimental Data for Research Reactors* (IAEA-TECDOC-1992), which compiles the benchmark studies performed, for the benefit of operating organizations, researchers, regulatory bodies, reactor designers, technical support organizations and other parties interested in benchmarking the computer codes and models.

A new Neutron Applications Portal web platform was released with the main objective of serving as a unique source of information for research and applications using research reactors and accelerator-based neutron sources.

The Technical Meeting on Research Reactor Radioisotope Production, held in Vienna, discussed the demand and supply challenges of medical and industrial radioisotopes produced using research reactors, in preparation for a publication on the topic.

Participants in the tenth African Conference on Research Reactor Safety, Operation and Utilization, held in Cairo, discussed common issues, options and strategies and exchanged experience on good practices regarding safe management, effective operation and enhanced utilization of these facilities.

New research reactor projects, infrastructure development and capacity building

The Agency re-designated the Research Institute of Atomic Reactors in the Russian Federation as an International Centre based on Research Reactors, providing researchers from various countries the opportunity to use its unique experimental facilities.

A Training Workshop on the Preparation of a Feasibility Study for a New Research Reactor Project: Experiences and Challenges, and a Training Workshop on Technical Requirements in the Bidding Process for a New Research Reactor, provided participants with practical guidance on implementing important steps in developing new research reactor programmes following the Agency's Milestones approach.

Two Regional Research Reactor Schools conducted in Japan and the Russian Federation and the 17th Eastern European Research Reactor Initiative group fellowship held in Austria, the Czech Republic and Slovenia trained young professionals in a broad range of topics related to safe operation and effective utilization of research reactors.

Participants in the Regional Research Reactor School attending practical training at the KUR research reactor, Kyoto University, Japan, October 2022.

Research reactor fuel cycle

The Agency published *Practices for Interim Storage of Research Reactor Spent Nuclear Fuel* (IAEA Nuclear Energy Series No. NF-T-3.10), which helps industry professionals at operating research reactors and storage facilities to identify the most suitable approach for interim storage of spent fuel.

A Technical Meeting on the Management of Irradiated Uranium Waste from Molybdenum-99 Production Using Low Enriched Uranium Targets provided a means for Member States to share experience of the disposition of waste products from their production of the world's most widely-used medical radioisotope. The Agency also cooperated in organizing and hosted the first Molybdenum-99 International Symposium.

A Technical Meeting on Lessons Learned from High Enriched Uranium Take-back Programmes kicked off the preparation of a publication that will assist in planning and executing shipments of spent research reactor fuel.

Research reactor operation and maintenance

The Operation and Maintenance Assessment for Research Reactors (OMARR) missions in Chile and Poland helped these Member States to improve the availability and reliability of their research reactors.

Technical Meetings on Utilization Related Design Features of Research Reactors, on Operation, Maintenance and Ageing Management for Research Reactors, and on Preparation for Decommissioning for Research Reactors allowed participants to share their experiences of managing different stages of the research reactor life cycle.

Participants in a Training Workshop on Non-Destructive Examination, In-Service Inspection and Online Monitoring Techniques of Research Reactors acquired information on the topic and practical training at an operational research reactor.

Hands-on training on in-service inspection at the TRIGA II research reactor of the Vienna University of Technology, April 2022.