

Nuclear Fuel Cycle and Materials Technologies

Objective

To advance the development and implementation of an increasingly safe, reliable, efficient, proliferation resistant and environmentally sustainable nuclear fuel cycle (NFC), providing the maximum benefit to Member States. To assist and support Member States in strengthening their capabilities and improving practices in radioactive waste management (RWM), decommissioning and remediation of contaminated sites and to support States embarking on nuclear power and developing countries to develop necessary RWM infrastructure. To collect data on damaged fuel and storage facilities and to assist Member States discuss and share ideas and information on nuclear fuel behaviour under severe conditions. To assist Member States decommission nuclear sites affected by accidents and to remediate off-site contaminated areas.

Uranium Resources and Production

The Agency updated and expanded its World Distribution of Uranium Deposits (UDEPO) database to include more than 1000 additional uranium deposits and 800 new deposit locations, including unconformity type uranium deposits. The work was carried out during two consultants meetings held in Vienna in August and September.

In May, the Agency organized a Training Workshop on Uranium Geochemistry in the Asia-Pacific Region, held in Thailand. The workshop, with 36 participants from 19 countries, highlighted the sustainability related challenges of geochemical aspects of uranium recovery using a comprehensive extraction approach, with a focus on technical, environmental, economic, governance and social issues.

A Technical Meeting of the Uranium Mining and Remediation Exchange Group (UMREG) was held in Bessines-sur-Gartempe, France, in October (Fig. 1). Over 40 experts from



FIG. 1. Participants in the UMREG Technical Meeting review the map of the Bernardan site during a field trip to observe historic and current remediation activities of former uranium mines in the area.

20 Member States and an international organization discussed the management of legacy situations, and the safe and appropriate development of uranium resources. Participants highlighted the importance of considering post-mining and post-processing issues during the planning and operational stages of a project.

The 54th Meeting of the Joint OECD/NEA–IAEA Uranium Group was held in Paris in November, with 48 delegates from 33 countries. Participants discussed the latest estimates of worldwide uranium supply and demand, to be included in *Uranium 2018: Resources, Production and Demand* (the ‘Red Book’).

Nuclear Power Reactor Fuel

Through coordinated research projects (CRPs) and training meetings, the Agency continued to assist Member States in sharing information on the development, design, manufacture and performance assessment of fuel for all types of nuclear power reactor. Particular emphasis was given to the development of fuels with increased accident tolerance and the analysis of fuel behaviour in accident conditions.

At the third Research Coordination Meeting of the CRP entitled ‘Reliability of High Power, Extended Burnup and Advanced PHWR Fuels’, held in Vienna in October–November, the project’s five partners, from five Member States, evaluated the final results of this CRP, which seeks to resolve the challenges involved in deploying advanced pressurized heavy water reactor fuels. In November, the third Research Coordination Meeting of the CRP entitled ‘Fuel Modelling in Accident Conditions (FUMAC)’ was held in Vienna. The 24 project partners from 18 Member States evaluated the final results of the CRP, aimed at better understanding the behaviour of nuclear fuel in accident conditions in order to enhance nuclear safety.

The Agency expanded its technical and training programme in the field of nuclear power reactor fuel, holding meetings on nuclear fuel in the Islamic Republic of Iran, Poland and Viet Nam.

Management of Spent Fuel from Nuclear Power Reactors

The first Research Coordination Meeting of the CRP entitled ‘Management of Severely Damaged Spent Fuel and Corium’ was held in Vienna in February. The project, involving seven Member States, is aimed at expanding the existing knowledge base and identifying optimal approaches for managing severely damaged spent fuel.

In October, the Agency hosted the first Research Coordination Meeting of the CRP entitled ‘Ageing Management Programmes for Dry Storage Systems’, involving five Member States. Meeting participants exchanged the latest research and development, and experience related to the ageing of systems, structures and components, and to monitoring, inspection and surveillance programmes.

Eighteen experts from ten Member States attended a Technical Meeting on Advanced Fuel Cycles to Improve the Sustainability of Nuclear Power through the Minimization of High Level Waste, held in Vienna in October. Participants discussed different technical perspectives of different spent fuel management options currently under consideration by Member States, focusing on waste burden minimization, with the aim of producing an Agency technical report for policy and decision makers.

Radioactive Waste Management, Decommissioning and Environmental Remediation

The Agency continued to assist its Member States in addressing a wide range of radioactive waste challenges. In July, it conducted the first Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) mission. The 12 day mission to the State-owned Nuclear Plant Management Company (SOGIN) reviewed Italy's programme for decommissioning nuclear facilities and managing radioactive waste. The Agency also conducted an ARTEMIS review of Poland's National Plan of Radioactive Waste and Spent Nuclear Fuel Management, in October. Requests for ARTEMIS reviews were received from eight other Member States.

The Agency updated and expanded its e-learning content on 'Spent Fuel and Radioactive Waste Management', 'Decommissioning' and 'Environmental Remediation'. Three new modules were added to the 'Radioactive Waste and Disused Sealed Radioactive Sources (DSRS) Management' course. Three additional modules were included in the 'Environmental Remediation' course, and updates were made to the 'Geological Disposal' course. The e-learning materials under this curriculum, comprising nine courses (48 modules and 94 lectures), can be accessed on-line at the Agency's learning management system on the Cyber Learning Platform for Network Education and Training (CLP4NET).

Radioactive Waste Management

In response to Member State interest in the planning of radioactive waste management activities, the Agency issued *Selection of Technical Solutions for the Management of Radioactive Waste* (IAEA-TECDOC-1817). The new publication identifies and reviews criteria for selecting waste management technologies, compares different technical options and offers a systematic approach to selecting the most appropriate solution.

The Agency finalized the report on the first phase of the project entitled 'Status and Trends in Spent Fuel and Radioactive Waste Management'. The project, carried out in close cooperation with the European Commission and the OECD/NEA, was designed to promote the benefits of reporting inventories of spent nuclear fuel and radioactive waste.

The Agency published *Use of the Benchmarking System for Operational Waste from WWER Reactors* (IAEA-TECDOC-1815), providing an overview of best practices for benchmarking low and intermediate level waste generated and managed during the normal operating life of water cooled, water moderated reactors. Such benchmarking can help Member States to minimize waste arising during operation.

Decommissioning and Environmental Remediation

Over 110 participants from 26 Member States attended the Workshop on Current and Emerging Methods for Optimising Safety and Efficiency in Nuclear Decommissioning, organized by the Institute for Energy Technology, Norway, in collaboration with the Agency and the OECD/NEA. The workshop addressed current topics such as practical applications of research and development as well as advanced technologies in decommissioning. Workshop participants confirmed the importance of information exchange between decommissioning researchers and implementers.

The Agency published the proceedings of the International Conference on Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes, held in Madrid, Spain, in 2016. The publication provides a summary of each session, current challenges, and the main approaches to further advance decommissioning and environmental remediation, as identified by participants. In December, it issued *Data*

Analysis and Collection for Costing of Research Reactor Decommissioning (IAEA-TECDOC-1832), providing representative input data and benchmarking data needed to estimate the overall cost of decommissioning during the early planning stages.

Management of Disused Sealed Radioactive Sources

The Workshop on Strengthening Security of Radioactive Sources in Central Asia, organized by the Agency in cooperation with the Nuclear Threat Initiative, the Moscow-based Center for Energy and Security Studies and the Government of Kazakhstan, was attended by 50 experts from 6 Member States. Participants highlighted the need for continued assistance to Member States in building and enhancing the capacities of both regulators and operators, in order to strengthen nuclear and radiological security in the region.

The Agency provided support to Member States in assessing the available options for the management of disused sealed radioactive sources (DSRSs), including co-disposal with other waste at suitable facilities, recycling and repatriation, and disposal in dedicated boreholes. It continued its support for borehole disposal projects in Ghana and Malaysia, including commissioning tests of key equipment.

The Agency supported preparations for the removal of 37 Category 1 and 2 sources from Albania, the Plurinational State of Bolivia, Ecuador, Lebanon, Paraguay, Peru, the former Yugoslav Republic of Macedonia, Tunisia and Uruguay; the removals are scheduled for completion in 2018. The Agency also helped train some 200 local personnel from over 20 Member States in the conditioning and safe and secure management of Category 3 to 5 DSRs. Missions for conditioning DSRs were conducted to Belize, China, the Dominican Republic, Ghana, the Islamic Republic of Iran, Jamaica and Malaysia.

In an effort to scale up the safe and secure management of DSRs, the Agency introduced a new concept of Qualified Technical Centres. The aim is to increase the worldwide capability to manage DSRs by encouraging countries with well equipped centres and trained personnel to provide technical services for the management of DSRs within their countries and regionally. The concept was launched at a side event during the 61st regular session of the Agency's General Conference.

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