Nuclear Fuel Cycle and Material Technologies

Objective

To strengthen the capabilities of interested Member States for policy making and strategic planning, technology development and implementation of safe, reliable, economically efficient, proliferation resistant and environmentally sound nuclear fuel cycle programmes.

Uranium Production Cycle and Environment

The Agency and the OECD/NEA finalized the latest update of the biennial "Red Book", *Uranium 2003: Resources, Production and Demand,* containing data from 44 countries. In 2002, uranium production totalled 36 042 t U (tonnes uranium), down from 37 022 t U in 2001. Of 20 countries reporting output, two (Canada and Australia) accounted for over 51% of world production, and seven (Australia, Canada, Kazakhstan, Namibia, Niger, Russian Federation and Uzbekistan) accounted for 87% of world production. Newly mined and processed uranium provided 54% of world reactor requirements (66 815 t U), the remainder being met by secondary sources including civilian and military stockpiles, reprocessed uranium, and re-enriched depleted uranium. The uranium market remains uncertain in the medium term due to the limited information available on secondary supplies, which are expected to decline in importance. After 2015, in particular, reactor requirements will have to be increasingly met by the expansion of existing production capacity, the development of additional production centres or the introduction of alternative fuel cycles. Market uncertainty has fuelled the recent increase in spot market prices, which have increased more than 70% since the end of 2002.

Nuclear Fuel Performance and Technology

To assist Member States in enhancing the predictive capabilities of codes used in fuel behaviour modelling for extended burnup, the Agency initiated a CRP on fuel thermal performance, fission gas release and pellet to clad interaction at burnups above 50 MW d/kg HM (heavy metal). The CRP will also address the performance of codes used for transient analysis such as for reactivity initiated accidents and for loss of coolant accidents at extended burnup. Idealized fuel histories were prepared in 2003, including histories supplied by two fuel vendors, and 16 teams of fuel modellers are currently working on the priority cases identified at the first Research Coordination Meeting. In related work, the Agency supported a conference in Bulgaria in September on fuel performance and modelling with particular reference to WWER fuel.

A summary of the present status of mixed oxide (MOX) fuel technology was published as Technical Reports Series No. 415. The topics covered: design; fabrication; performance; in-core fuel management; transport; spent MOX fuel management; decommissioning; waste treatment; safeguards; and alternative approaches for both civil and ex-weapons plutonium recycling. The main focus was on MOX fuel for thermal power, although several aspects of fast reactor MOX fuel were also addressed.

Spent Fuel Management

In June the Agency hosted an international conference on the storage of spent fuel from power reactors to identify the most important directions for national efforts (Figs 1 and 2) and international cooperation. Potential Agency initiatives emphasized at the conference included assistance to Member States in coordinating research on the long term behaviour of spent fuel, and the continuing exchange of information on related technology and public acceptance matters. The proceedings of this conference, as well as details on related Agency activities, are available at *http://www.iaea.org/OurWork/ST/NE/index.html*. Other technical documents on spent fuel management issued in 2003 included the final report of the CRP on spent fuel performance assessment and research (SPAR) (IAEA-TECDOC-1343) and the proceedings of a technical meeting on burnup credit (IAEA-TECDOC-1378).

Nuclear Fuel Cycle Issues and Information Systems

At an international conference on innovative technologies for nuclear fuel cycles and nuclear

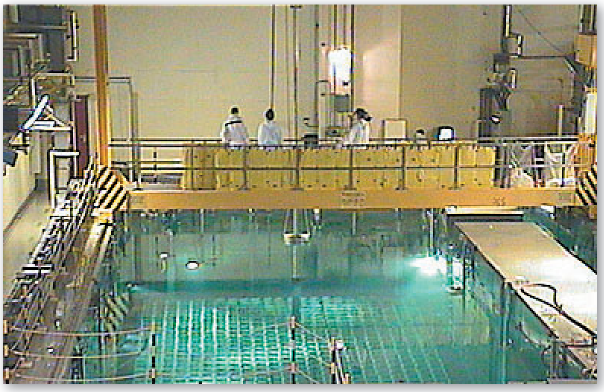

FIG. 1. Spent fuel pool after re-racking was completed at the Krško nuclear power plant, in Slovenia.

FIG. 2. Interim storage and transport casks at ZWILAG, in Switzerland.

power, held in Vienna in June, discussions of future nuclear fuel cycles ranged from an emphasis on national energy security through a closed thorium fuel cycle to growth in mature markets based on regional energy security, limited or small waste volumes and environmental impacts, and a balance between the supply and demand of raw materials at the front end of the fuel cycle. A number of conference participants noted that many innovative fuel cycle concepts focus explicitly on the back end and aim especially at dealing with the remaining waste. Many also favoured the introduction of additional waste management options, such as partitioning and transmutation, to reduce the mass and radioactivity of wastes requiring disposal.

The development and maintenance of databases and information systems are important aspects of the Agency's nuclear fuel cycle programme. Recognizing that data sources, when regularly updated and revised to meet changing needs, provide essential technical support for fuel cycle activities in Member States, the Agency updated and expanded its nuclear fuel cycle databases. For example, the web site devoted to nuclear fuel cycle information (*http://www-nfcis.iaea.org*) was completely redesigned and now includes three databases and one simulation system: the Nuclear Fuel Cycle Information System; World Distribution of Uranium Deposits; Post-Irradiation Examination Facilities; and the Nuclear Fuel Cycle Simulation System. ■