Return to Sender

Upgrading the Safety & Security of Research Reactors

How the world's nuclear research reactors are fuelled makes a difference. In fact, the type of fuel they use has become a serious concern on safety and security grounds. A focal point is fresh and spent highly enriched uranium (HEU) fuel that remains on site at many shut down research reactors, says the IAEA's Crosscutting Co-ordinator for Nuclear Research Reactors, Mr. Iain Ritchie.

Since 1993 the Agency has worked to help countries upgrade safety and security at research reactors, particularly at shut-down reactors that have no plans for decommissioning and decontamination. The problems are significant, funds limited, and the work ever growing.

Spent Fuel at Reactors

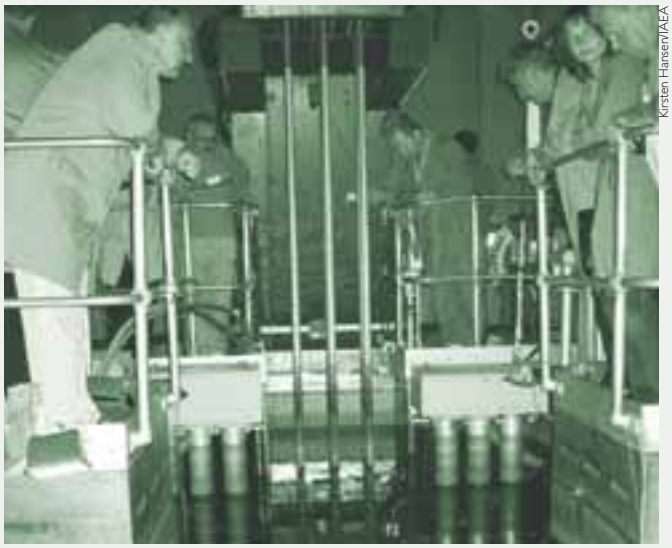
Researchers have long used small nuclear reactors as engines of discovery for everything from lifesaving cancer treatment to electronic gadgetry. But the use and future of research reactors is radically changing in a more economically competitive, and safety-conscious world.

Historically, HEU was the fuel of choice to power research reactors. It is also a key safeguarded material that can be processed and used to make a nuclear weapon. Most research reactors are located in nuclear-weapon States, but some are in countries yet to conclude safeguards agreements with the Agency.

"To have to imagine that all this spent fuel, in all these little research reactors, is scattered all over the world is crazy," says Mr. Allan Krass, Physical Science Officer, US State Department. "We know of a number of countries where the economy is in intensive care, the political situation is completely unstable and yet they have a research reactor with a spent fuel pool," Mr. Krass said.

In the past, the US supplied the bulk of HEU fuel and reactors in North America and the Asia Pacific, while the former Soviet Union supplied enriched fuel and HEU reactors to Eastern Europe. There are various "take back" initiatives underway to return this spent fuel to the countries of origin for safe disposal.

"There is no country that enjoys taking back spent fuel — it's a political headache. Yet it is irresponsible to just imagine that you can leave that where it is indefinitely," Mr. Krass said.



Kirsten Hansen/IAEA

La Reina research reactor in Santiago, Chile.

In some cases stocks of highly radioactive spent fuel are stored in an unsafe manner, corroding away. In other instances, spent fuel had been building up for years, for longer periods, and in large quantities, than originally planned. About one-third of all spent research reactor fuel is HEU spent fuel. The IAEA's research reactor database reveals the extent of the spent fuel problem:

◆ 12,850 spent fuel assemblies of US origin still at research reactors abroad. Most are eligible to be returned under the US "take back" program, as long as they are discharged before 13 May 2006.

◆ 24,803 spent fuel assemblies originally enriched in the former Soviet Union still at research reactors abroad. A Tripartite (IAEA, Russian Federation, US) Initiative to repatriate this fuel is expected to begin this year.

Of the 382 shut down research reactors worldwide, less than half are decommissioned. The IAEA's focus is on the 27 shut down research reactors in developing Member States.

"Of the 27 in question, those with safety concerns and serious spent fuel problems are well known to us and we are trying to improve maters," Mr. Ritchie said. Of particular pri-

ority, reactors that have been shut down for more than a year with no plans for decommissioning; and reactors or spent fuel storage pools housing leaking fuel assemblies or exotic fuels that require special management.

The Agency's work in this area includes:

◆ Enhancing the safety of facilities and spent fuel storage, including support for the return of fuel to the country of origin;

◆ Correcting institutional shortcomings through training and guidance, and providing limited monitoring equipment in chronic cases;

◆ Identifying and supporting upgrades to physical security at vulnerable sites;

◆ Developing long-term measures to improve security and creating a common safety culture. This includes encouraging States to sign on to the new Code of Conduct on the Safety of Research Reactors that goes before the IAEA General Conference in September 2004.

Fresh Fuel at Reactors

Stocks of unused, fresh HEU fuel also become a liability when a research reactor shuts down. Fresh HEU fuel — material not yet used in a nuclear research reactor — is low in radioactivity. This makes it far easier for a thief to transport than the highly radioactive spent fuel wastes.

"What we are talking about is weapons-grade material that is not self-protecting - material that is not so radioactive that people can't just pick it up and carry it away," Mr. Krass said.

The IAEA is helping Member States to transfer unwanted fresh HEU stocks back to the country that supplied it. In August 2002 it helped transfer 45 kilograms (enough fissile material to make two nuclear bombs) from Serbia and Montenegro back to Russia, to be blended down to low-enriched uranium (LEU) that cannot be used in a nuclear weapon. Most recently it assisted Libya in March 2004. In December 2003 it assisted Bulgaria and in September 2003, Romania. More return shipments are planned in other countries.

Stop HEU Trade

Currently about 130 research reactors around the world still run on weapons-grade HEU. In an article "A Safer World" published in The Economist, IAEA Director General Mohamed ElBaradei called for an end to trade in HEU.

"Existing facilities around the world that use high-enriched uranium applications — for example, to produce medical radioisotopes — should continue, gradually but irreversibly, to be converted to low-enriched processes."

The Agency is helping countries do exactly that. It actively supports them to convert their research reactors from burning HEU to LEU. In conjunction with the US "Reduced Enrichment for Research and Test Reactors" (RERTR) programme the Agency is helping to reduce and eventually eliminate international commerce in HEU for research reactors.

So far 29 reactors have been fully converted to LEU and a further seven are in the process of converting. Countries seeking IAEA assistance include Brazil and Romania.

Safety and security is a twin challenge of rising proportions as more and more research reactors are shut down or decommissioned this decade. The IAEA stands ready to help but with limited resources improvements come slowly, says Mr. Ritchie. Signs fortunately are pointing to more international support and co-operation in months and years ahead.

— Kirstie Hansen, IAEA Division of Public Information. For more information see the feature series on the IAEA web site www.iaea.org.

Code of Conduct

The Code of Conduct on the Safety of Research Reactors goes before the IAEA General Conference in September 2004 for adoption, having been approved by the Board of Governors at its March 2004 meeting.

The Code establishes "best practice" guidelines for the licensing, construction and operation of research reactors. At its core, "the safety of the public, the environment and the workers," said IAEA Director of Nuclear Installation Safety, Mr. Ken Brockman.

Research reactors were excluded from the Convention on Nuclear Safety when it was drawn-up in the early 1990s. The need for an overarching Code of Conduct came to a head in a resolution at the 2000 IAEA General Conference, prompted by safety concerns as many of the worlds' research reactors approached the end of their originally planned lifespans. Increased fears of terrorist threats following the 11 September 2001 attacks in the United States also helped to fuel desire for a Code of Conduct, Mr. Brockman said. Just less than half of the world's 272 research reactors still operate using highly enriched uranium — a key ingredient for a nuclear bomb.

The Code is a non-binding international legal agreement, where States determine their own level of commitment to its guidance. The Code was derived from more detailed international standards that have been promulgated for the safe day-to-day operation, construction, shutdown and decommission of research reactors, Mr. Brockman said. "It will pave the way for the continued evolution of these standards," he said.

The Agency has already carried out numerous safety and security missions at research reactors which, among other things, has helped to improve the security infrastructure at reactors.