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The group visited the underground characterization facility, ONKALO, in the demonstration tunnel 1, at about 420 meters depth. Photo credit Posiva/Helka Suomi.*

Finland Sets a Good Example

The Disposal of Spent Fuel Is in the Foreseeable Future

After several presentations, discussions and, finally, seeing the Finnish bedrock 420 metres below the ground, the IAEA representatives — Director General Yukiya Amano, Juan Carlos Lentijo and Conleth Brady — were briefed on the feasibility of a deep underground disposal facility for spent fuel. “ONKALO, the underground characterization facility, shows that a safe solution for the back end of the nuclear fuel cycle is not only talk but reality,” states Mr Lentijo, Director of the Division of Nuclear Fuel Cycle and Waste Technology .

“Based on the extensive amount of research, experience and information gained during the construction of the ONKALO underground characterization facility, we became convinced that what we just saw is a real example of how to resolve the final destination of the spent nuclear fuel in a safe way,” Mr Lentijo explains.

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** From left, back row: 1. Mr Reijo SUNDELL, President, Posiva Oy, 2. Mr Kimmo Kemppainen, Research Manager, Posiva Oy, 3. Mr Lauri HIRVONEN, First Secretary, Permanent Mission of Finland in Vienna, 4. Mr Conleth BRADY, IAEA. From left, front row: 1. Mr Yukiya AMANO, Director General, 2. Mr Tero VARJORANTA, Director General, Radiation and Nuclear Safety Authority, 3. Mr Juan Carlos LENTIJO, IAEA, 4. Mr Herkko PLIT, Deputy Director General, Head of Nuclear Energy Division, Ministry of Employment and the Economy.*

Fuelling the Safe and Secure Use of Nuclear Technologies

Three months have already passed since I started my duties as the Director of the Division of Nuclear Fuel Cycle and Waste Technology (NEFW). It didn't take that long to become aware of the highly competent and committed professional team I would be leading. This is the best possible asset to support Member States in their plans to start, develop or expand their national nuclear energy programmes. And, it is therefore necessary to thank my predecessors at the NEFW for their vision and their contribution to building this Division!

Though people change, the IAEA will continue to stand for a safe, secure, proliferation resistant and sustainable use of nuclear technologies. To support its Member States, the IAEA and our Division provide practical guidance, review services, training and catalyse technology development and innovations related to nuclear fuel cycles, waste management and research reactors. To fulfil our role, the NEFW endorses cross-cutting cooperation and information exchange among the interested Member States.

Bearing this in mind, good technology and operational practices are crucial contributors to a high level of safety and reliability of nuclear facilities. Nuclear safety culture starts with strong design, but most importantly with professional people committed to high safety standards. This combination leads to sound operational practices and should be taken into consideration when striving for safe use of nuclear energy. After all, the accumulated experience in the use of nuclear energy — including the production of energy and the associated fuel cycle activities — brings us to the conclusion that the safer an installation operates the better performance it achieves.

The IAEA is currently preparing the Programme and Budget (P&B) for 2014–2015. This work gives us an excellent opportunity to assess our achievements obtained in the current budged cycle and the challenges for the next one. In addition, this assessment will help us to define the priorities for the next P&B in the areas of fuel cycle, waste technology and research reactors, taking due consideration of the IAEA Medium Term Strategy, the Nuclear Safety Action Plan and other post-Fukushima actions.

Among others, priorities will include those related to the damaged nuclear fuel, the decontamination and decommissioning of facilities, off-site remediation and associated waste management. The great reliability and safety of all steps of the nuclear fuel cycle and fuel supply will continue to be a matter of high priority, as well as activities for enhancing the behaviour and safety of research reactors and converting them from high enriched uranium (HEU) to low enriched uranium (LEU) fuel and shifting molybdenum-99 production to LEU based methods.

Taking into account the different needs of Member States, our Division will continue to fuel the safe and secure use of nuclear technologies.

Juan Carlos Lentijo, Director (J.C.Lentijo@iaea.org)

Action Plan Status

Significant progress has been made in the Action Plan programme since its launch at the IAEA General Conference a year ago. As part of identifying and sharing lessons learned in the light of the Fukushima Daiichi nuclear accident, the IAEA has convened international experts' meetings on:

- Reactor and Spent Fuel Safety in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant;
- Enhancing Transparency and Communication Effectiveness in the Event of a Nuclear or Radiological Emergency;
- Protection against Extreme Earthquakes and Tsunamis in the Light of the Accident at the Fukushima Daiichi NPP.

The next big meeting is scheduled for January 2013 on 'Decommissioning and Remediation after a Nuclear Accident'.

To increase transparency, the IAEA has listed on its web site all the facilities and countries where it has completed peer reviews focused on safety or where such reviews are planned. It has posted the results of all completed reviews under its Integrated Regulatory Review Service and summary results of other peer reviews. All its peer review services have also been adjusted as needed to incorporate lessons learned from the Fukushima Daiichi accident.

In addition, the IAEA has upgraded its own emergency response plan to provide better information during an emergency. To strengthen national emergency preparedness and response, it has organized 21 national, regional and interregional training events in the first half of 2012. More than 15 more have been planned for the second half of the year. →

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"So far, the most critical discussions, especially in the media, have been around the *concept* of spent fuel disposal, but it is not true anymore to argue that there is no technical solution available."

Besides the technical, there are, of course, other sides to the success story of Posiva, the implementer of the deep repository project.

"Practically, it all culminates in three basic elements: the adoption of a national responsible policy for waste management; having a safe technical solution and a suitable geo- and demographic location; and explicit and transparent communication. Expertise of the implementer and the regulatory body are of the higher importance as well," the Director states.

Thousands of kilometres of pipes, welds and cables; building volume of 1 000 000 cubic metres… The visit to TVO also included a site tour to the huge construction site of Olkiluoto 3. Hosted by the Project Director Jouni Silvennoinen (middle), Juan Carlos Lentijo (left) and Yukiya Amano were updated on the current status of the project. Photo courtesy of TVO/Tiina Kuusimäki.

Credits to the independency of regulator

The visit to Finland included meetings with the President of Finland and Ministers of Foreign Affairs and Economic Affairs, a visit to STUK (the regulatory body), and site visits to Olkiluoto, a small island on the west coast of Finland where Posiva and the nuclear power plant operator Teollisuuden Voima (TVO) are located.

"At Olkiluoto, we saw in practice how a power plant is operated; how a new unit is being build and how the spent fuel repository project is proceeding. Before that we had visited the STUK headquarters. I must give my compliments to the Finnish Government for giving STUK the necessary independence to regulate the Finnish nuclear field," Lentijo says.

"…it is not true anymore to argue that there is no technical solution available."

The expertise of STUK is widely acknowledged. For example, it had a big role when stress tests were carried out in Europe.

"STUK is perceived as a strong regulator with integrity, competence and independence. These ingredients build trust in nuclear power and its regulation. In addition, informing and involving people timely to the decision-making process has positively contributed to achieving the high level of public acceptance as they have in Finland," Lentijo claims.

"Of course, credit should also be given to the power plant operators TVO and Fortum as well as Posiva. They all have a consistent message: safety comes first."

In fact, even though Finland's 5th nuclear power plant project is delayed by several years, it must not be seen as a negative issue when it's the best of the safety and security.

"I believe that Finland is a forerunner in many things, particularly in those related to the disposal of spent fuel. Sharing with the international community its experience in managing nuclear waste and new nuclear power plant projects will be of great benefit for the nuclear world," Mr Lentijo summarizes.

Hanna Kajander (H.Kajander@iaea.org)

The IAEA has begun revising its Safety Standards to incorporate lessons from the accident and has already revised its guidance for countries introducing nuclear power. It published an Operations Manual for Incident and Emergency Communication to improve the implementation of the Early Notification and Assistance Conventions and made available a protected web-based Unified System for Information Exchange in Incidents and Emergencies. It has also published Communication with the Public in a Nuclear or Radiological Emergency with guidance for those responsible for keeping the public and media informed during an emergency.

As the work to make nuclear power production safer is continuous, activities related to the Action Plan will continue to be of high importance. The development of the programme can be followed at www.iaea.org/newscenter/focus/actionplan/.

Alan McDonald (A.McDonald@iaea.org)

The old, high enriched uranium (HEU) fuel used in TRIGA Mark III contained approximately 5 kilograms of fresh HEU fuel and 5 kilograms of spent HEU fuel, enriched up to 70% uranium-235. Now the reactor runs by a fuel containing fuel enriched to less than 20% uranium-235. The IAEA's Director General Mr Yukiya Amano (on right) witnessed the completion of the conversion project. Photo courtesy of National Institute of Nuclear Research (ININ).

Mexican TRIGA Mark III Is Now Fuelled with LEU

Converting high enriched uranium (HEU) fuelled research reactors to burn low enriched uranium (LEU) fuel is an important component of the IAEA'S work to prevent proliferation of nuclear weapons. The latest achievement in this category took the representatives of the IAEA to Mexico. There they congratulated their Mexican colleagues for the successful completion of the TRIGA Mark III conversion project.

Mexico has three research reactor facilities: two zero-power subcritical assemblies, and a 1 MW TRIGA Mark III research reactor. Until February, US-origin HEU fuel was used in the TRIGA research reactor.

"IAEA was requested to assist the conversion process in 2010. As a response to the official request, the Director General, Yukiya Amano assured Mexico that the IAEA would work with them to convert the reactor, secure the necessary LEU fuel, and repatriate US-origin HEU fuel," says Mr Pablo Adelfang, the Head of the Research Reactor Section.

Following Mexico's request, and in consultation with both Mexican and American representatives, the IAEA Secretariat prepared a Project and Supply Agreement (PSA) covering the replacement of HEU fuel by LEU fuel. The PSA was approved by the Board of Governors, and entered into force for all three parties (the IAEA, the USA, and Mexico) in August 2011.

"A Supplemental Contract to the PSA was finalized two months later. The supplement identified the terms and conditions for the transfer of LEU and HEU fuel. These terms called for LEU fuel to be transferred by the United States, through the Agency, to Mexico. After the LEU fuel was transferred, Mexico would ship its HEU fuel — both spent and fresh — to the USA, through the IAEA," Mr Adelfang explains.

From Paper Work to Action

While the final legal arrangements were being worked out, the IAEA was already working with Mexico to ensure the quality of the fuel that was being manufactured by CERCA in Romans, France. An IAEA project officer, a consultant from Romania and members of the Mexican conversion team spent four days at the CERCA plant in October 2011 and inspected the LEU fuel being manufactured.

"Two months after the first shipment of LEU fuel to Mexico was delivered by a US military aircraft. This shipment included 85 LEU fuel assemblies — enough for the full conversion of the Mexican research reactor. The USA also delivered empty containers needed to ship back the fresh HEU fuel," the section head says.

The second shipment of 40 LEU spare fuel assemblies was inspected in January 2012, and the shipment arrived in Mexico in February — again delivered by US military aircraft.

"This time the same aircraft took back to the USA the containers with all the fresh HEU fuel. Mr Amano and I were present at the ceremony for the transfer of the title from Mexico to the USA through the IAEA," Mr Adelfang says. "The spent HEU fuel, again, was then shipped back to the USA separately from the port of Veracruz."

Conversion of research reactors from HEU to LEU fuel is not a business invented yesterday. The development work to convert facilities using high enriched uranium to the more proliferation resistant low enriched uranium fuels and targets dates back to the late 1970's.

Hanna Kajander (H.Kajander@iaea.org)

Considerations and Milestones for a Research Reactor Project

Getting a Research Reactor Up and Running

The complexity of the infrastructure issues associated with a new research reactor depends upon the type of research reactor selected, the scope of any pre-existing nuclear infrastructure in the country, and the availability of human and technical resources. To facilitate the comprehension of these issues, the IAEA has established four distinct phases of research reactor implementation.

'Specific Considerations and Milestones for a Research Reactor Project' is a recently published IAEA Nuclear Energy Series report (NP-T-5.1) that provides guidance on the timely preparation of a research reactor project. It includes a detailed description of the range of infrastructure issues that need to be addressed as well the expected level of achievement at the end of each phase.

Phase 1: Pre-project — Research Reactor Justification

A research reactor project can take many forms. The type, size, power and cost of the research reactor designs and its ancillary facilities should be matched to the needs of the potential stakeholders and to the financial resources that are available.

The ancillary facilities include such items as educational facilities, neutron beam lines and instrumentation, isotope preparation hot cells and chemical processing facilities, etc.

A research reactor cannot be utilized without the ancillary facilities. The quality and adequacy of the ancillary facilities therefore determine in a large part the usefulness and effectiveness of the research reactor.

A research reactor may be constructed to meet the requirements of a single Member State, or it may be constructed to serve as a regional or international centre of excellence, helping to meet the needs of both the initiating Member State and its neighbours or collaborators. Developing the case for a regional facility is more difficult and complex, but is potentially highly beneficial, providing higher utilization, additional human and financial resources, and helping to elevate the scientific stature of the host Member State.

It is indispensable to assess stakeholders' needs, to develop the initial strategic plan for the research reactor, and to adapt the research reactor's specifications to meet the identified needs.

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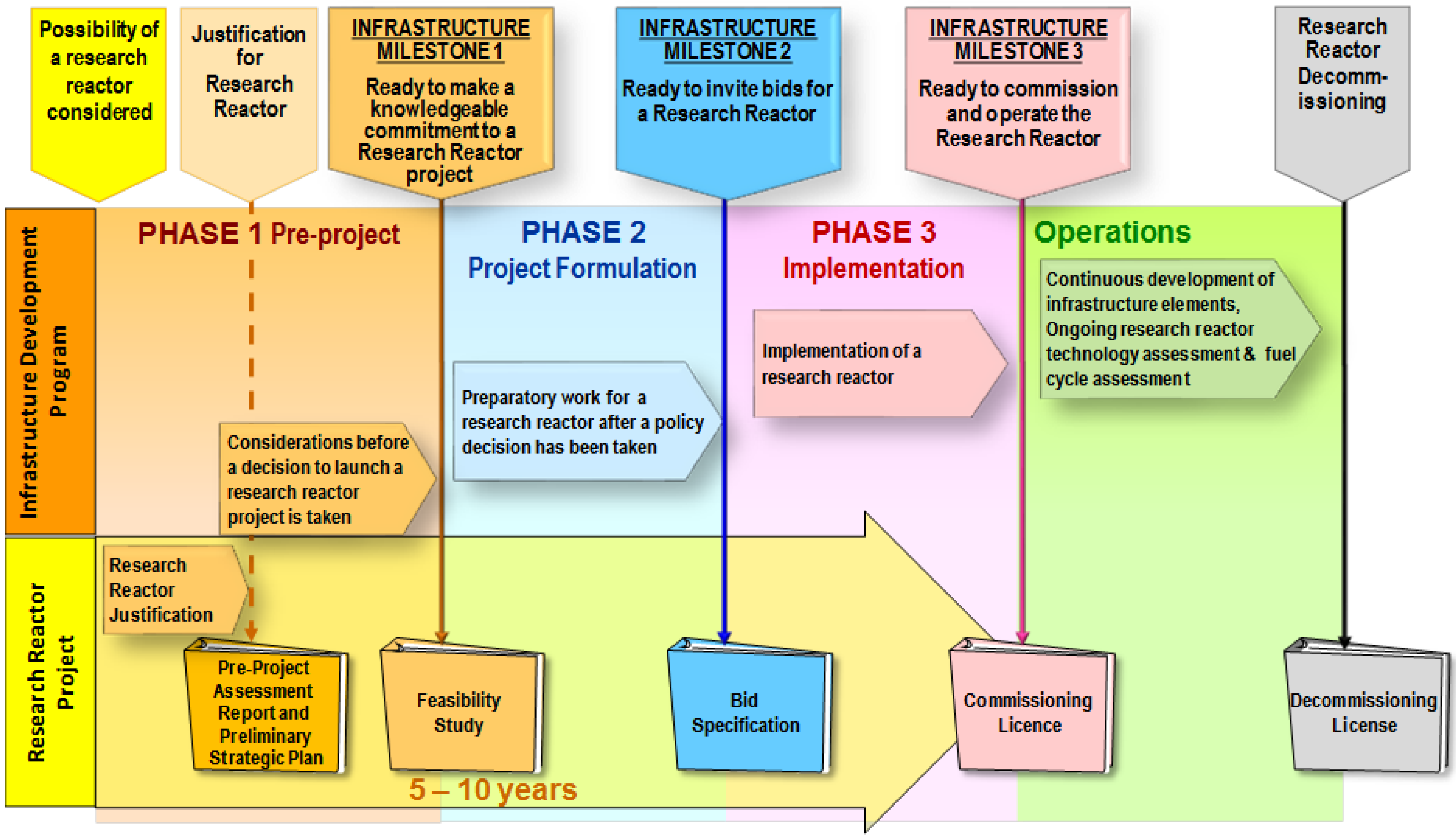

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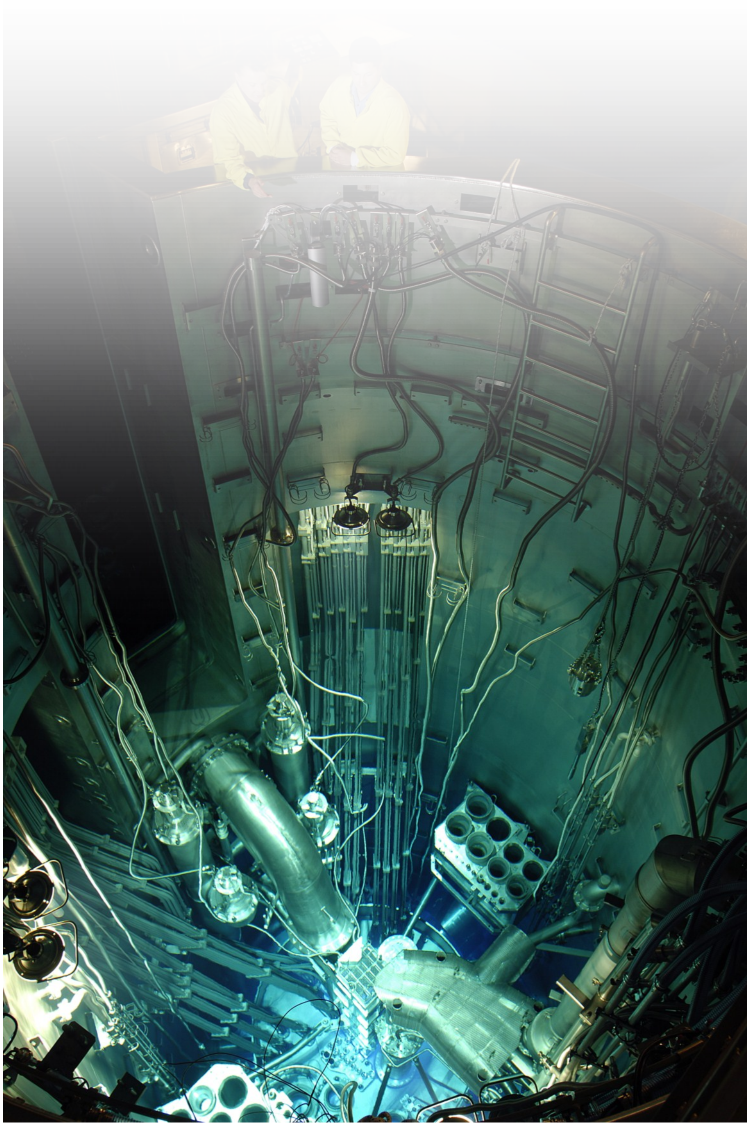
Milestone 1: Ready to Make a Knowledgeable Commitment to a Research Reactor Project

During the first phase, the Member State completed the Pre-Project Assessment and Preliminary Strategic Plan and determined that there are scientific, industrial or medicinal needs that may justify the construction of a research reactor.

However, before embarking upon the research reactor project, the Member State must develop a comprehensive understanding of the obligations and commitments involved, and ensure that there is a long term national strategy and resources available to discharge them. This work will culminate in the attainment of Milestone 1 and the production of the Feasibility Report which demonstrates that the Member State is in a position to make an informed decision whether to proceed with the research reactor project. The Feasibility Report will incorporate and update the Pre-Project Assessment and Preliminary Strategic Plan and integrate these with the analysis of the obligations, commitments and resources required.

Such assessments could build confidence that the country has the ability to legislate, regulate, construct and safely and securely operate a research reactor.



Milestone 2: Ready to Invite Bids for the Research Reactor

Following the policy decision to proceed with the development of a research reactor project, substantive work for achieving the necessary level of technical and institutional competence should be undertaken. This second phase requires a significant and continuing commitment from the government and from the operating organization.

During the second phase of the programme, the country will carry out the work required to prepare for the construction of a research reactor. For example, the nuclear legislation will need to be enacted before proceeding with a request for bid for the first research reactor, and the regulatory body will need to be developed to a level at which it can fulfil all of its oversight duties.

Before the commencement of the bidding process, the licensing stages and activities to be licensed should be defined, including safety and security requirements for the bidding process itself. The necessary infrastructure should be developed to the point of complete readiness to request a bid or enter into a commercial contract. It is assumed that the country may use the competitive bid process to purchase the first research reactor; however, it is acknowledged that there are a number of different procurement processes for the acquisition of the first reactor, including securing the supply of necessary nuclear fuel.

To ensure proper accomplishment of the operating organization obligations, the second phase also includes development of an effective management system and staff capabilities. The operating organization has a key role at this time in ensuring that it has developed the competences to manage a nuclear project, to achieve the level of organization, operational culture, and safety culture necessary to meet the regulatory requirements, and the ability to demonstrate that it is an adequately informed and effective customer.

Milestone 3: Ready to Commission and Operate the Research Reactor and Its Ancillary Facilities

The third phase of the programme development consists of all the activities necessary to implement the first research reactor and complete most of the infrastructure development. During this phase, the greatest capital expenditures will occur. Attention by all organizations is crucial to the successful outcome and all have important roles to play.

At the end of this phase the operating organization will have developed from an organization capable of ordering a research reactor to an organization that can accept responsibility for commissioning and operating one.

When a country wishes to construct a research reactor, the IAEA publication on 'Specific Considerations and Milestones for a Research Reactor Project' can help by providing a detailed description of the range of infrastructure issues that need to be addressed.

Procedures and arrangements to ensure safe control of research reactor under all conditions will have been developed as well as significant development and training for all levels of staff.

While achieving the third milestone is a major accomplishment, it should be remembered that it is only the beginning of a lasting commitment to the safe, secure and effective utilization of the research reactor.

Who can benefit from the publication?

The publication can be used by Member States to assess their own status with regard to justification and resourcing for a research reactor, and the development of the necessary supporting infrastructure.

The document will enable prioritization of the activities that are needed to order, license, construct and then safely operate the research reactor. This guidance aims to help Member States to understand their commitments and obligations associated with the research reactor programme, and clarifies that the responsibility for safe implementation of a research reactor project rests with the Member State and its organizations and cannot be subcontracted or avoided.

Other organizations such as donors, suppliers, nuclear energy agencies and utility organizations may also find this publication useful as a basis for project assessment. Such assessments could build confidence that the country has the ability to legislate, regulate, construct and safely and securely operate a research reactor.

The publication has been produced within the IAEA Department of Nuclear Energy and Department of Nuclear Safety, with inputs from the Department of Nuclear Sciences and Applications, Department of Safeguards, the Office of Legal Affairs and the Office of External Relations and Policy Coordination.

Pablo Adelfang (P.Adelfang@iaea.org)

Manual Being Finalized about Evaluating Costs of **Decommissioning Research Reactors**

To have a research reactor up and running, a lot of time, effort and money have to be invested. But, even in the planning stage some thought should be given to the end of the useful lifetime of such a facility — costs included.

One of the main concerns in the back-end of any nuclear facility is the cost of decommissioning and related activities. For a research reactor, this has been an area where, until now, evaluating methods have not been fully addressed.

To fill the gap, the IAEA supported development of CERREX software (Cost Estimate for Research Reactors in Excel) for robust cost estimates of research reactors decommissioning. The software was developed in Microsoft Office Excel format due to the worldwide distribution of this software and no needs in specialized software training.

As a basis for CERREX cost calculation structure, the costing model uses the International Structure for Decommissioning Costing (ISDC) that is recommended by the IAEA, OECD/NEA and EC as a general platform for decommissioning costing purposes. Use of the ISDC based costing model facilitates the preliminary costing stages with the absence of decommissioning plans. For proper setting of the costing case, the intended decommissioning strategy is used. The costing model should be flexible as to the extent and details of the inventory data. The impact of individual inventory items (working constraints) should be respected. Implementing the ISDC as the basis for the cost calculation structure ensures compatibility with the IAEA classification of radioactive waste.

Though the manual is not yet printed, the CERREX software has been successfully used and implemented in two European countries and in Japan. The finalization of the manual as well as experiences of the practical implementation of the software will be reported in the later issues of NEWF newsletter.

Vladimir Michal (V.Michal@iaea.org)

Preservation of Records, Knowledge and Memory across Generations

The preservation of records, knowledge and memory (RK&M) for future generations is seen as an integral part of responsible radioactive waste management. It supports, for example, lengthy and complex socio-technical processes across pre-operational, operational and post-operational lifetimes of nuclear facilities. Long term preservation of RK&M is an emerging multidisciplinary work area in which much learning is expected over the coming years.

Disposal in engineered facilities built in stable, deep geological formations is the reference means for permanently isolating long-lived radioactive waste from the human biosphere. This management method is designed to be intrinsically safe and final, i.e. not dependent on human presence and intervention in order to fulfil its safety goal. There is, however, no intention to forgo, at any time, knowledge and awareness either of the repository or of the waste that it contains.

The preservation of RK&M in waste disposal is an unprecedented task in which technical, scientific and social information is interwoven and needs to be developed and preserved across generations and across specialist boundaries.

Progress has been made in individual countries, but there is a need to internationalise the thinking, compare approaches, investigate potential solutions and share decisions. To this end, in 2009 OECD/NEA started a programme of work in the area of long term preservation of information and memory. The interdisciplinary forum offers an appropriate venue for exploring and helping to develop guidance on regulatory, policy and technical aspects of long term preservation of information and memory that are closely linked to the implementation of waste management programmes.

Current members encompass representatives from Canada, Finland, France, Hungary, Sweden, Switzerland, the United Kingdom, the USA and the International Atomic Energy Agency. The project has the support of the European Commission and is sponsored by the Radioactive Waste Management Committee of the NEA.

A major outcome of the project will be a 'menu-driven document' that will allow people to identify the main elements of a strategic action plan for RK&M preservation.

National programmes would benefit from a shared, broad-based and documented understanding, at the international level, of the range of methods and concepts for the long term preservation of information and memory. Such understanding — technical, institutional, societal and culture-specific — could be used as a reference for those national programmes that are involved in siting and licensing repositories, or that are involved in other long term projects. Such understanding would also foster the development of more robust strategies and regulations for national radioactive waste management programmes whatever their stage of implementation.

Peter Ormai (P.Ormai@iaea.org)

Where Do We Stand with EPPUNE?

In the fields of nuclear energy, science and technology, communication is an important prerequisite to ensure legitimacy of technical and societal decision making. Through EPPUNE activities, the IAEA continues to seek ways to promote and facilitate the exchange of experience in this area.

"Science and technology alone cannot fully address stakeholders' needs and concerns. Especially in the areas of radioactive waste management, decommissioning and environmental remediation, the need to consider the societal dimensions is evident," says Mr Peter Ormai, a Waste Disposal Specialist (Waste Technology Section) with long experience in dealing with stakeholders' matters.

To better address this societal dimension, an Expanded Programme of Public Understanding on Nuclear Energy, abbreviated as EPPUNE, encourages a balanced and informed debate on nuclear energy by fostering excellent communications skills and transparency.

"EPPUNE taps into a broad range of areas of stakeholder communication throughout the life cycle of nuclear facilities," adds Mr Akira Izumo, a Public Information Specialist in the Waste Technology Section and coordinator of the EPPUNE activities.

Though Mr Izumo is a newcomer at the IAEA, he already has a clear idea of how to proceed with the EPPUNE programme.

"For several years training events and workshops consisting of lectures and practical exercises on communication activities and programmes have been successfully organized with the help of EPPUNE funds. I fully support these activities also in the future as they have been widely appreciated by the Member States," Mr Izumo says. "In addition, I would like to see time and money invested on developing educational material to the public, for example, about radioactive waste."

Besides organizing meetings, development of a Communicator's Toolbox, and of an internet training course (e-learning) materials on stakeholders' participation, as well as preparation of a video on radioactive waste management are among the projects for which EPPUNE money is being used this year.

The main objectives of EPPUNE activities are not to give Member States tools to bend public opinion towards a positive attitude, but to help communicators to grasp the factors affecting public opinion and to develop or improve a communication strategy based on this understanding.

"If we look into the future of EPPUNE, an increasing number of the Member States have been requesting for assistance on stakeholder communication issues. Hence, to better meet the increasing demands of the public, EPPUNE continues to provide its Member States a wide variety of activities to enhance stakeholder communication skills," Mr Ormai comments.

"After all, sharing experiences and learning from different methods helps to develop successful interaction between technical and social aspects in nuclear energy and waste management programmes," Mr Izumo concludes.

For further information on EPPUNE, please contact the technical officers Peter Ormai (P.Ormai@iaea.org) or Akira Izumo (A.Izumo@iaea.org).

Hanna Kajander (h.kajander@iaea.org)

Did you know?

The activities of EPPUNE are supported financially by the Japanese Government through the Ministry of Economy, Trade and Industry.

The programme was established in 1990.

Besides EPPUNE, the following thematic networks within the Waste Technology Section offer an opportunity to complement workshops and similar activities on technical issues by also addressing issues related to stakeholder communication:

- The URF Network (Underground Research Facilities Network);
- The IDN (International Decommissioning Network)
- DISPONET (International Low Level Waste Disposal Network);
- ENVIRONET (Environmental Management and Remediation Network); and
- The LABONET (International Network of Laboratories for Nuclear Waste Characterization).



Two irradiators had been stored for years under unsafe and insecure conditions in a bunker. While recovering them, a radium-contaminated capsule was also found in the bunker. All of them were removed, after which the bunker was cleaned and closed.

Recovering Irradiators in Costa Rica

If you look for a country that matches the coordinates 9°56'N 84°5'W, you end up locating Costa Rica, a 51100 km^2 country with a population of 4.3 million people in Central America. To visit the country for a holiday is surely a pleasant and warm experience. To visit the country as an international expert to help the country in the recovery of misplaced, high activity sealed sources is everything else but a holiday.

"The IAEA got an official request to help Costa Rica in the safe recovery, decontamination, characterization, transportation and storage of two irradiators last year. The Waste Technology Section (WTS) agreed to organize the mission and, by the end of February 2012, the team of three experts had all the necessary things sorted out to be able to conduct the mission," tells Mr **Juan Carlos Benitez-Navarro**, the IAEA expert and the leader of the mission team. The other two, non-IAEA experts were **Juan Miguel Hernandez** and **Janos Balla**.

"These irradiators were stored in a bunker at the area of CATIE, Tropical Agriculture Research and Higher Education Center in Turrialba, Costa Rica. From the very few information available at CATIE we learned that they were used several decades ago at a 'gamma garden' where experimental irradiation was carried out on different plantations," Mr Benitez-Navarro says. "Later the experiments finished because some contamination was measured around the cobalt irradiator."

Since the irradiators had been stored in a contaminated bunker since 1989, there was a definite necessity for putting the sources under continuous control at a safe and secure location. Therefore Costa Rica asked the IAEA's help to eliminate the unsafe and insecure situation.

"This direct assistance to the Member States of the IAEA has been and still is an important task in improving the safety of people. I'm happy to see, however, that the IAEA's efforts of the recent years have effectively improved the safety and security of disused radioactive sources in many countries. Even though there is a good number of countries where help is still needed, less countries struggle with this problem nowadays ," Mr Benitez-Navarro states.

The mission covered all aspects

The purpose of the mission included all aspects connected to the decontamination and recovery of the two self-shielded irradiators located in a concrete bunker:

(i) Characterization of the initial situation with the cobalt-60 contamination of the irradiators and interior of the storage bunker;

(ii) Decontamination of the two devices containing high activity radioactive sources and their preparation for safe handling, management and transportation;

(iii) Transport of the sources from CATIE, Turrialba, to safe storage in San Jose.

"As Costa Rica does not have a radioactive waste repository,

The irradiators are now safely and securely stored until they will be removed out of the country either to the country of origin or to an agreed waste disposal facility.

Mission diary

Monday, 27 February, Costa Rica. The IAEA-organized team met with the local organizer of the mission i.e. the representatives of the Ministry of Health (MoH). Details and logistics of the mission were discussed and all safety related forms and documents as well as authorization for all operations to be conducted were prepared.

Tuesday, 28 February. The IAEA team and MoH representatives travelled to CATIE, Turrialba. A controlled zone and proper working conditions were established before opening the bunker. Smear tests and dose rate measurements were conducted regularly. The irradiators were cleaned and decontaminated inside the bunker and then removed. The team searched the interior of the bunker for additional hot spots; a small plastic capsule containing radium-226 wet powder was found and recovered. Once both irradiators and the radium-contaminated capsule were removed, the bunker was closed.

Wednesday, 29 February. It's Leap Day! No way the team could leap, though. Instead the internal parts of the irradiators were decontaminated and cleaned. The irradiators were painted and prepared for transport, including appropriate identification and immobilization of source movement mechanisms as the high activity sources are not to escape their shields during transport! In order to distribute the weight of the heavy containers onto a larger area of the truck, a metallic base was designed and constructed. Additionally, a metallic frame was designed and prepared to firmly fix the irradiators on the metallic base.

Thursday, 1 March. The MoH issued the transport licence for the two irradiators. The driver was instructed on his responsibilities and duties during transport and emergency situations. Team leader accompanied the truck driver during the 70 kilometre's transport. Conditions were safe, speed appropriate and the vehicle was escorted both in front and in back. Before, during and after the transport, the dose rate on the surface of the vehicle was measured as well as the dose rate at the driver's cabin.

Friday, 2 March. The transport vehicle was parked overnight in a secure and guarded parking area and in the morning the two irradiators were unloaded and placed in the storage facility with a crane and a fork lift truck. In the afternoon, the mission's findings and recommendations were discussed. The national source inventory and source management strategy were also updated.

Mission accomplished!

Juan Carlos Benitez-Navarro
(J.C.Benitez-Navarro@iaea.org)

the mission also included placing both of the irradiators in a safe and secure temporary store. They are going to be removed from the country finally," Benitez-Navarro relates.

As the two recovered irradiators — together with three other disused high activity sources — are included in a project for source removal from Costa Rica, more stories from Costa Rica are expected in the future.

Hanna Kajander (H.Kajander@iaea.org)

Did you know?

Irradiators can be used, for example, to expose products such as food, food containers, spices, medical supplies and wood flooring to radiation.

The purpose is, among others, to eliminate harmful bacteria, germs and insects or for hardening.

The gamma radiation does not leave any radioactive residue or cause any of the treated products to become radioactive themselves.

The radioactive source is typically cobalt-60.

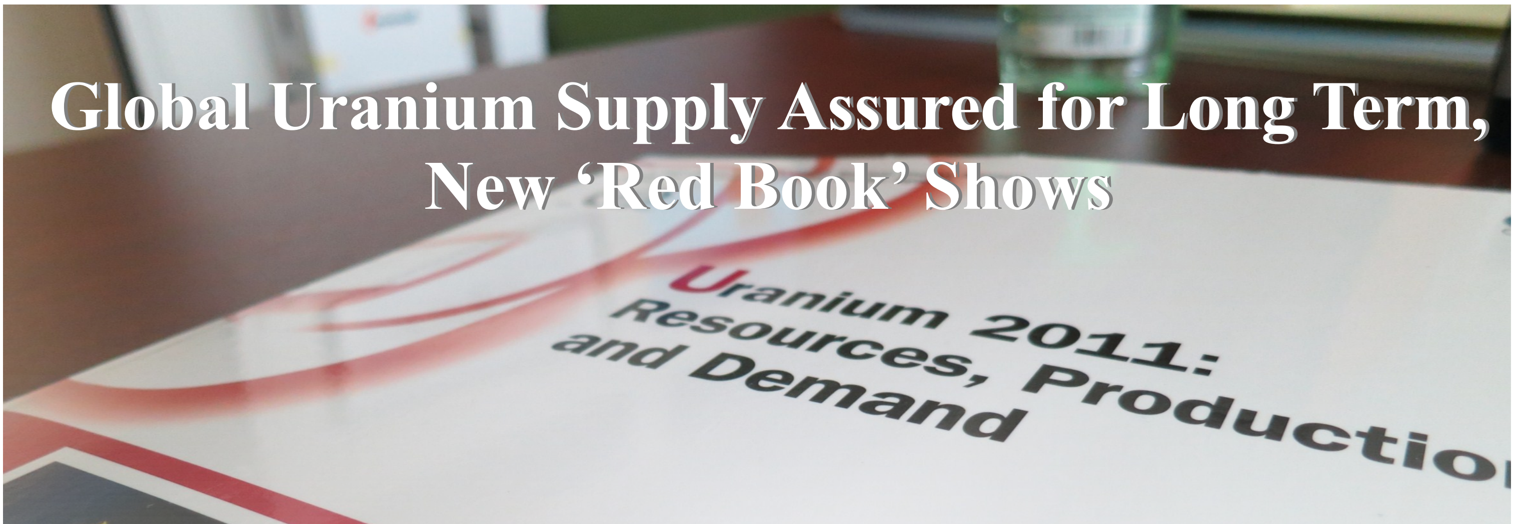
After their useful lifetime, the irradiators become radioactive waste, often named as disused sealed radioactive sources (DSRS) that need to be properly managed.

Unused high activity sources are being stored for long periods of time in many countries. The longer the storage time, the greater the probability of accidents and deliberate misuse.

The IAEA has and continues to improve the safety and security conditions in Member States by performing DSRS conditioning and removal projects.

The bunker was marked with a plate, the 'souvenir' in the hands of the mission team leader, Juan Carlos Benitez-Navarro. Job well done together with the other team members, Juan Miguel Hernandez and Janos Balla (middle).

Global Uranium Supply Assured for Long Term, New 'Red Book' Shows



The long term availability of uranium is often questioned. Based on the recently published Red Book 2011, a report by the OECD Nuclear Energy Agency (OECE/NEA) and the International Atomic Energy Agency (IAEA), uranium resources and production are on the rise with the security of uranium supply assured for the long term.

The Red Book 2011 shows that total identified uranium resources have grown 12.5% since 2008, to approximately 7 million tonnes of uranium metal. These figures, which reflect the situation as of 1 January 2011, mean that total identified resources are sufficient for over 100 years of supply based on current requirements.

"The increased resource base has been achieved thanks to a 22% increase in uranium exploration and mine development expenditures between 2008 and 2010, which in 2010 totalled over US $2 billion. However, the costs of production have also increased, leading to reductions in lower cost category resources," states Ms Adrienne Hanly, Uranium Resources Specialist and co-author of the Red Book 2011.

"Global uranium mine production increased by over 25% between 2008 and 2010. Largely because of the contribution of Kazakhstan, currently the world's leading producer of uranium, which also means the in situ leaching (ISL) mining technique now dominates production methods, accounting for 39% of recent production," Hanly says. According to Hanly, demand for uranium is expected to continue to rise for the foreseeable future.

"Although the Fukushima Daiichi nuclear accident has affected nuclear power projects and policies in some countries, nuclear power remains a key part of the global energy mix and growth and support of the industry continues in many nations," she claims.

In fact, several governments have plans for new nuclear power plant construction, with the greatest expansion expected in China, India, the Republic of Korea and the Russian Federation.

"However, the speed and magnitude of growth in generating capacity elsewhere is still to be determined. Projected growth is from 375 gigawats (GW) in 2010 to between 540 GW and 746 GW by 2035 which corresponds with annual uranium requirements of ~64000 tonnes of uranium (t U) in 2010 to between 98000 t U and 136000 t U by 2035. The currently defined uranium resource base is more than adequate to meet high case demand requirements through 2035 and well into the foreseeable future."

Timely investments required

Although ample resources are available, meeting projected demand will require timely investments in uranium production facilities. This is because of the long lead times — typically in the order of ten years or more in most producing countries — required to develop production facilities that can turn resources into refined uranium ready for nuclear fuel production.

"With uranium production ready to expand to new countries, and in particular developing nations, efforts are being made to develop transparent and well-regulated operations similar to those used elsewhere to minimize potential environmental and local health impacts. Although not the primary focus of the Red Book, activity updates on the environmental aspects of the uranium production cycle are included in the national reports in this edition," states Adrienne Hanly.

While the status of supply and demand is considered from the perspective of technologies in use today, the deployment of advanced reactors and fuel cycle technologies can also positively affect the long term availability of uranium, conceivably extending the time horizon of the currently defined resource base to thousands of years.

About the Red Book

(i) The latest report of the *Uranium 2011: Resources, Production and Demand*, commonly referred to as the 'Red Book', was released in July 2012.

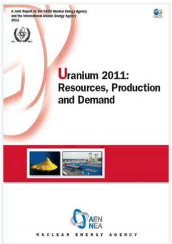
(ii) It was the 24th edition of this periodic assessment (currently every two years). It has been published since the mid-1960s.

(iii) The Red Book is largely based on the responses to questionnaires provided by the IAEA Member States.

(iv) Production of the Red book is a major recurring activity of the Raw Materials and Resources Sub-programme of the Nuclear Fuel Cycle and Materials Section of Division of Nuclear Fuel Cycle and Waste Technology, in cooperation with the OECD/NEA.

Peter Woods (P.Woods@iaea.org)
Hanna Kajander (H.Kajander@iaea.org)

Recent Publications

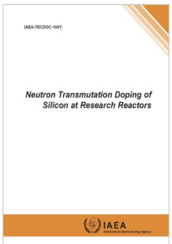


Uranium 2011: Resources, Production and Demand

A Joint Report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency (NEA No. 7059). (2012)

Orders: OECD Online Bookshop

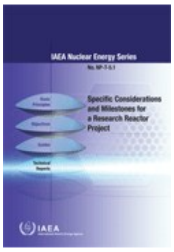
www.oecdbookshop.org/oecd/index.asp?CID=&LANG=EN



IAEA-TECDOC-1681

Neutron Transmutation Doping of Silicon at Research Reactors (2012)

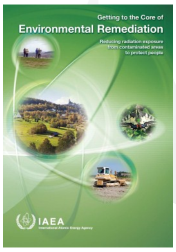
www-pub.iaea.org/MTCD/Publications/PDF/TE_1681_web.pdf



IAEA Nuclear Energy Series NP-T-5.1

Specific Considerations and Milestones for a Research Reactor Project. (2012)

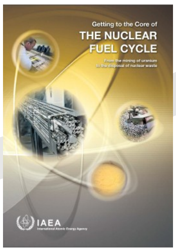
www-pub.iaea.org/books/IAEABooks/8843/Specific-Considerations-and-Milestones-for-a-Research-Reactor-Project



Getting to the Core of Environmental Remediation

The brochure provides general information about environmental remediation areas, from planning to the implementation of remediation projects, including stakeholder involvement. (2012)

www.iaea.org/OurWork/NE/NEFW/_nefw-documents/Environmental_Remediation.pdf

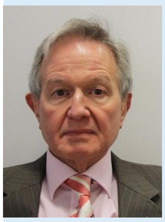


Getting to the Core of the Nuclear Fuel Cycle

The brochure briefly describes the various steps of the nuclear fuel cycle by covering areas from mining and milling to disposal of radioactive waste. (2012)

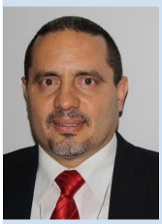
www.iaea.org/OurWork/NE/NEFW/_nefw-documents/NuclearFuelCycle.pdf

Introduction of the Authors



Pablo Adelfang is the head of the Research Reactor Section, which covers utilization, modernization and refurbishment, infrastructure, research reactor fuel cycle, operation and maintenance and new research reactor projects.

Alan McDonald is the Programme Coordinator for the Department of Nuclear Energy, including the Nuclear Fuel Cycle and Waste Division, the Nuclear Power Division, the Planning and Economic Studies Section, the Nuclear Knowledge Management Section and the Nuclear Information Section.



Juan Carlos Benitez is a Nuclear Engineer in the Waste Technology Section. The focus is on providing support to Member States upgrading their Disused Sealed Radioactive Source (DSRS) infrastructure and strengthening their technical/operational capabilities to safely and securely manage DSRS.

Vladimir Michal is the team leader of Decommissioning and Environmental Remediation team in the Waste Technology Section. His work includes wide range of technical and non-technical aspects related to decommissioning of nuclear facilities and environmental remediation of contaminated sites.

Akira Izumo is a Public Information Specialist in the Waste Technology Section and is involved in activities that aim at improving public knowledge communication in the field of nuclear fuel cycle. He coordinates overall activities of EPPUNE.

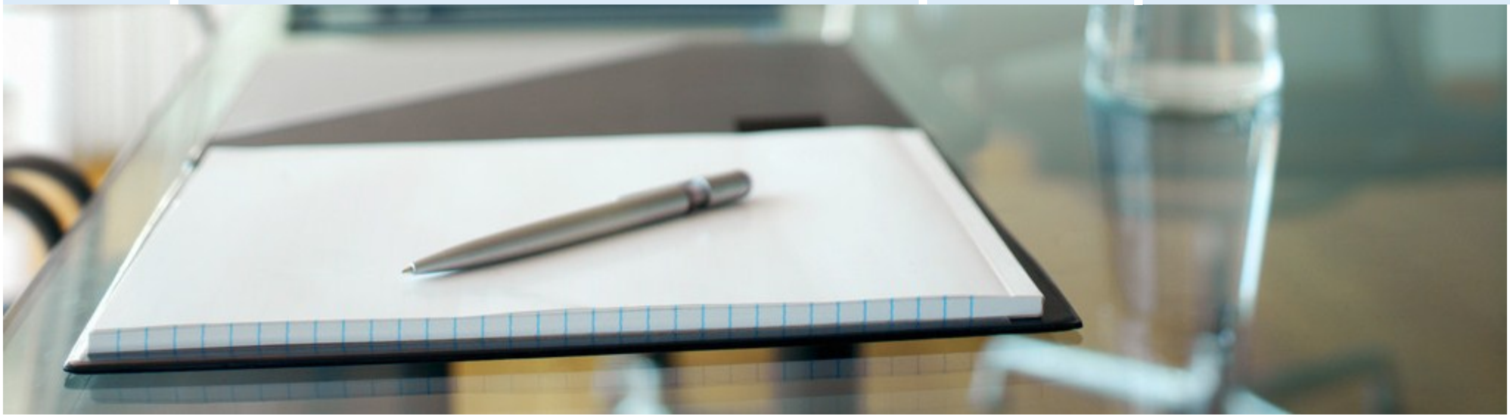
Peter Ormai is a Waste Disposal Specialist in the Waste Technology Section. His work focuses on providing support to Member States in their efforts to develop and operate radioactive waste disposal facilities. He is the scientific officer of the international network of low level waste disposal (DISPONET).

Hanna Kajander is a Communications Specialist in the Division of Nuclear Fuel Cycle and Waste Technology and is involved in activities that aim at improving public knowledge on radioactive waste management and nuclear fuel cycle.

Peter Woods is the team leader of the Raw Materials and Resources Sub-programme in the Nuclear Fuel Cycle and Materials Section. The team supports Member States with the Uranium (and Thorium) Production Cycle, from the discovery and responsible mining and milling of ores into their final concentrated forms prior to processing into nuclear fuels.

Upcoming Meetings in 2012

Date	Title	Place	Contact
24–27 Sep	TM on Fuel Integrity During Normal Operating and Accident Conditions in Pressurized Heavy Water Reactors (PHWR)	Bucharest Romania	U.Basak@iaea.org
1–3 Oct	TM on the Uranium Production Cycle Network on Education and Training (UPNET)	Vienna Austria	P.Woods@iaea.org
8–12 Oct	2nd RCM on Benchmarking of advanced materials pre-selected for innovative nuclear reactors	Rome Italy	V.Inozemtsev@iaea.org
15–19 Oct	Training Workshop for NEWMDB Country Coordinators	Vienna Austria	J.Kinker@iaea.org
22–24 Oct	TM on Extending Spent Fuel Storage beyond the Long Term	Vienna Austria	A.Bevilacqua@iaea.org
22–24 Oct	RCM to Finalize Work Programme for the CRP on Near Term and Promising Long Term Deployment of Thorium Energy System	Vienna Austria	U.Basak@iaea.org
6–7 Nov	TM on Conversion Planning for Molybdenum (Mo-99) Production Facilities from High Enriched Uranium (HEU) to Low Enriched	Vienna Austria	A.Carrigan@iaea.org
6–8 Nov	Annual Forum of the International Decommissioning Network (IDN)	Vienna Austria	P.Osullivan@iaea.org
6–8 Nov	Plenary Meeting of the Network on Environmental Management and Remediation (ENVIRONET)	Vienna Austria	H.Monken-Fernandes@iaea.org
11–14 Nov	TR/Workshop on Environmental Remediation of Contaminated Sites and Life Cycle Environmental Management	Copenhagen Denmark	H.Monken-Fernandes@iaea.org
20–23 Nov	TM on the Optimization of In Situ Leach Uranium Mining Technology	Vienna Austria	A.Hanly@iaea.org
3–5 Dec	2nd RCM on Treatment of Irradiated Graphite to Meet Acceptance Criteria for Waste Disposal	Vienna Austria	Z.Drace@iaea.org
3–7 Dec	TM on Underground Research Laboratories for Geological Disposal of High Level Waste (URF)	Albuquerque USA	P.Degnan@iaea.org
4–7 Dec	TM on Trends in the Development of Advanced Fuels for Fast Reactors	Kalpakkam India	U.Basak@iaea.org
5–7 Dec	TM on Integrated Nuclear Fuel Cycle Information Management: Trends and Developments	Vienna Austria	H.Tulsidas@iaea.org
10–14 Dec	2nd RCM on Evaluation of Conditions for Hydrogen-induced Degradation of Zr Alloys During Fuel Operation and Storage	Villingen Switzerland	V.Inozemtsev@iaea.org
10–14 Dec	TM on Cost Estimation for Decommissioning	Vienna Austria	P.Osullivan@iaea.org
11–14 Dec	TM on Good Practice in Uranium Production Cycle	Vienna Austria	A.Hanly@iaea.org
17–21 Dec	TM on Risk Management and Decommissioning	Vienna Austria	P.Osullivan@iaea.org



Division of Nuclear Fuel Cycle and Waste Technology

Website Links

Division Introduction — The NEFW Home

- www.iaea.org/NuclearFuelCycleAndWaste

Nuclear Fuel Cycle and Materials Section (NFCMS)

- Main activities
  www.iaea.org/NE/NuclearFuelCycle
- Technical Working Group on Nuclear Fuel Cycle Options (TWGNFCO)
  www.iaea.org/NE/NuclearFuelCycle/twgnfco
- Technical Working Group on Water Reactor Fuel Performance and Technology (TWGFPT)
  www.iaea.org/NE/NuclearFuelCycle/twgfpt
- Integrated Nuclear Fuel Cycle Information System (iNFCIS)
  www.iaea.org/NE/NuclearFuelCycle/infcis

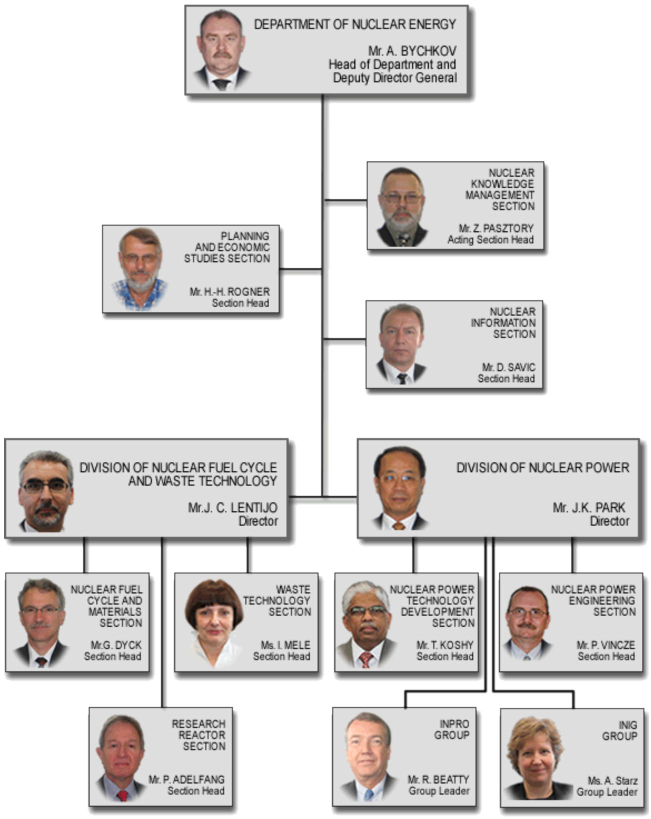
Waste Technology Section (WTS)

- Main activities
  www.iaea.org/NE/WasteTechnology
- International Radioactive Waste Technical Committee (WATEC)
  www.iaea.org/NE/WasteTechnology/watec
- Technical Group on Decommissioning (TEGDE)
  www.iaea.org/NE/WasteTechnology/tegde
- Databases (NEWMDB, DRCS)
  www.iaea.org/NE/WasteTechnology/databases

Research Reactor Section (RRS)

- Main activities
  www.iaea.org/NE/ReseachReactors
- Technical Working Group on Research Reactors (TWGRR)
  www.iaea.org/NE/ReseachReactors/twgrr
- Research Reactor Database
  nucleus.iaea.org/RRDB/RR/ReactorSearch.aspx?rf=1
- Research Reactor Ageing Database
  www.iaea.org/NE/ReseachReactors/AgeingDatabase

Organizational Structure

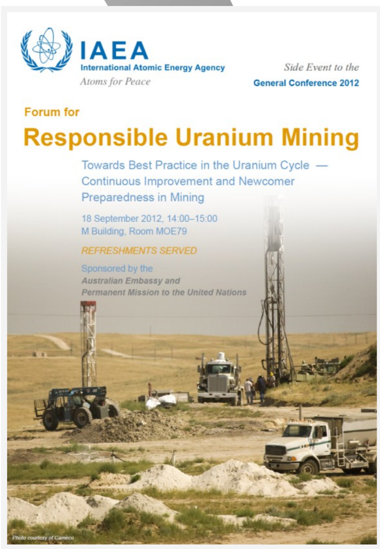


Nuclear Fuel Cycle and Waste Technology

In the Next Issue of the NEFW Newsletter

- NEFW at the General Conference 2012
- News from the International Conference on Geological Repositories
- Stakeholder Involvement News — Workshops in Denmark and Poland
- Research Reactors and Beyond Design Basis Events

NEFW Side Events at the General Conference 2012



Impressum

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