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# Fuel Cycle and Waste Newsletter

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## Contents



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*NEFW Director Juan Carlos Lentijo examines recovery work on top of Unit 4 of TEPCO's Fukushima Daiichi Nuclear Power Station, 17 April 2013. (Photo: G. Webb/IAEA)*

## Experts share advice for improvement

# Reviewing Fukushima Daiichi Decommissioning Plans

*An IAEA expert team encouraged Japan to continue with its efforts to decommission Fukushima Daiichi Nuclear Power Station. It also offered advice for improvement.*

The Government of Japan invited the IAEA to review its “Mid-and-Long-Term Roadmap towards the Decommissioning of TEPCO’s Fukushima Daiichi Nuclear Power Station (NPS) Units 1-4”. The mission from mission from 15 to 22 April 2013 was aimed at assessing strategy, planning and timing of decommissioning phases and reviewing short-term issues and challenges, such as the current condition of the reactors and spent fuel pools, the management of the huge amount of contaminated water accumulated at the site, as well as the radioactive releases.

The 13-member IAEA team, led by Juan Carlos Lentijo (Director, NEFW), held extensive discussions with officials from the Ministry of Economy, Trade and Industry (METI), Tokyo Electric Power Company (TEPCO), and the Nuclear Regulation Authority (NRA).

*Continued on p. 3*

# Cradle to Grave:

## Mining to Remediation

This issue of our Newsletter reaches you just before the IAEA's highest level policy making organ, the General Conference, meets for its 57th annual session.

One of our most important activities since the March issue was helping Japan with a review of its plans to decommission Units 1–4 of the Fukushima Daiichi Nuclear Power Station. This is a long and complex undertaking, once more highlighted by two recent events related to contaminated water. We are following the tireless efforts of the Japanese authorities to address these issues and we will continue offering our advice and help. For this, we are looking forward to conduct the second part of the decommissioning review.

I hope you will agree that this issue also reflects the diverse work our Division is engaged in. You will find first hand stories from places as diverse as Tanzania and Uzbekistan, and on topics as diverse as uranium mining, repatriation of highly enriched uranium research reactor spent fuel, recovering disused radioactive sources, waste and environmental remediation.

I thank all my colleagues, our experts in missions, meeting participants for their continuous efforts for a safe, secure, sustainable nuclear fuel cycle. We often have to bid farewell to experienced colleagues but thankfully manage to find new talents! Hence, we say thank you to Janet Davies and John Kinker of the Waste Technology Section and Alisa Carrigan of the Research Reactor Section for their work to date, and we welcome Ibrahim Miko Dit Angoula to the Nuclear Fuel Cycle and Materials Section, Sophie Gouzy-Portaix to the Research Reactor Section, Andressa Junger, Sharon Padua, Geraldina Robles and Cathleen Roughan, Kasturi Varley to the Waste Technology Section.

From mining to environmental remediation, we have to remember that nuclear is a field of constant improvement and innovation. In that sense, I hope our new App for the iPad, called *NE News* will make our Newsletters and technical publications easier to read. I encourage you to connect with us through our *website* and the *NE News App*, and on *Twitter* to help us improve.

Juan Carlos Lentijo, Director (j.c.lentijo@iaea.org)

# Communicating Decommissioning

## *Public trust issues can be addressed by constructive two-way dialogue and with consistent credible messages*

Involving stakeholders in and communicating about the decommissioning of Fukushima Daiichi NPS is one of the challenges the Japanese Government and TEPCO needs to deal with. There are understandable anxieties and concerns among local communities and the nation after the 2011 nuclear accident.

The Government and TEPCO have recognized that ensuring appropriate public understanding is indispensable for the decommissioning programme, and made considerable efforts to that end. The IAEA team, however, observed that they face difficulties in regaining public trust.

The incidents in 2013 related to electrical supply failures and the contaminated water leakages created further anxiety in the public. The IAEA team reviewed TEPCO's reporting and communication processes associated to these events. It was observed that there was a gap between the perceptions of TEPCO and those of the public and other stakeholders.

Hence, the IAEA team encourages TEPCO to conduct a comprehensive assessment of its current procedures for reporting to concerned parties and for communicating with the public, both in normal and abnormal situations. The conclusions of this assessment should be shared with stakeholders including the Nuclear Regulation Authority and local authorities to enhance coordination among different institutions and to help meet the public's expectations. A constructive two-way dialogue, using consistent and credible messages, would improve the credibility of the whole decommissioning programme.

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*Continued from p. 1*

The team visited the nuclear accident site to gain first-hand information about conditions and the progress towards the decommissioning of the facility.

*IAEA mission members on top of Unit 4 operating floor. (Photo: G. Webb/IAEA)*

**Progress made**

The Mission Report (http://www.iaea.org/newscenter/focus/fukushima/missionreport230513.pdf) acknowledged important progress in nine areas preparing Fukushima Daiichi NPS for decommissioning, such as:

- Japan has addressed the plant's decommissioning in a timely manner, as demonstrated by its early preparation of the Roadmap and its acceleration of plans to remove fuel from the spent fuel pools at Units 1-4. In addition, Japan has logical and rational plans for the most complex task: removing damaged fuel from the reactors;
- TEPCO has deployed advanced, large-scale treatment technologies for decontaminating and desalinating highly radioactive water that has accumulated at the site. The treated water has been used to successfully cool the damaged reactor cores;
- The Government and TEPCO have recognized the importance of effective stakeholder involvement and public communication in dealing with decommissioning programmes.

**Further advice**

The IAEA team also noted 17 areas where current practices can be improved, such as:

- Launching efforts to define an end-state of the Fukushima Daiichi NPS site would help focus decommissioning efforts. This effort should be pursued with effective stakeholder involvement;
- An assessment of TEPCO's incident reporting and communication practices – with the government, the regulator, and the public – could help to enhance stakeholder trust and respect;
- TEPCO should continue its efforts to improve the reliability of essential systems, to assess the structural integrity of site facilities, and to enhance protection against external hazards; and
- Measures should continue to improve management issues regarding radiation releases and exposures from the site, particularly issues created by the storage of accumulated water. The team encourages Japan to assess the overall benefit of the site-boundary dose limit, particularly in relation to the radiation levels at the site boundary due to solids and liquids stored at the site.

*The 13-member IAEA Team at Unit 4, 17 April 2013. (Photo: G. Webb/IAEA)*

**Updated Roadmap**

The Government of Japan and TEPCO have already begun using the advice in the course of revising the Roadmap. "Mid-and-Long-Term Roadmap towards the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Station Units 1-4, revised 27 June 2013" is available on METI website http://www.meti.go.jp/english/press/2013/pdf/0627_01a.pdf.

The second mission of the International Peer Review to Japan is planned for Q4 2013.

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# Managing Radioactive Waste

## *at Fukushima Daiichi NPS*

Radioactive waste management is a major challenge in decommissioning Fukushima Daiichi NPS. To overcome this challenge, it is necessary to have a strategy and long-term waste management plan based on estimates of volumes, types and characteristics of the different waste streams to be generated during all phases identified in the *Roadmap* for decommissioning.

In this respect, the end-state of the site is an important consideration because it has a crucial impact on waste quantities and long-term plans for waste management. The IAEA team highlighted this in their discussions with Japanese counterparts during the Peer Review Mission.

A major focus of on-going activities at the site is on treating large volumes of accumulated water for removing the radionuclide caesium and desalinating this treated water. More than half a million cubic metres of contaminated water have been treated so far. Treated water is being successfully used to cool the damaged reactor cores.

*Temporary storage of contaminated water in above ground tanks and underground reservoirs. (Photos: TEPCO)*

TEPCO is facing some challenges in managing both contaminated and treated water. One serious issue is the continuing inflow of groundwater into the reactor and turbine buildings. If TEPCO's planned groundwater bypass system to reduce this inflow proves to be successful, there will be less need to continuously increase water storage capacity.

Another issue of concern relates to recent reports of flow of contaminated groundwater to the sea. The source of this contamination is suspected to be highly radioactive water in one of the trenches connected to Unit 2 turbine building.

Also, the treated water still has substantial radioactivity due to the presence of strontium and other radionuclides. Its storage contributes to worker dose and presents the risk of leakage and potential spread of contamination. This risk was brought into focus when radioactive water was found to have leaked from some of the underground storage tanks in March 2013, and again from one of the above-ground tanks in August 2013, contaminating the surrounding soil.

A newly built advanced liquid-waste processing system (ALPS) for removing other radionuclides from caesium treated water is presently undergoing hot tests before regular operation. By removing all residual activity (except tritium) from the water, this facility is expected to substantially reduce the risks associated with water storage.

Assessing the current situation, the IAEA team encouraged TEPCO to review its overall strategy for accumulated water management and to work out a comprehensive plan taking into account the constraints and associated risks in the current approach in consultation with all relevant stakeholders, including the NRA and the public.

Spent sorbent columns and the sludge from the chemical precipitation process are two major secondary waste streams resulting from water treatment. The total volume of these secondary wastes is expected to be in the range of several thousand cubic metres, loaded with very high levels of radioactivity. While adequate facilities have been constructed to temporarily store these secondary wastes, the need for their processing and eventual disposal has been recognized in the *Roadmap* and relevant R&D activities in this regard are being pursued.

Solid waste, which include concrete debris (rubble), metal, contaminated trees and soil from various areas, is collected, segregated based on dose and temporarily stored. Debris is temporarily stored in earth trenches. Trees are collected in designated areas. The current inventory of solid waste at the site is around a hundred thousand cubic metres, a commendable effort by TEPCO.

Volume reduction technologies, especially for decreasing the enormous volumes of combustible and compactable solid waste will eventually be required.

An incinerator is under construction for treating combustible waste. While noting that current activities are well planned and implemented, the IAEA team pointed out the need to define a path forward for solid waste to be moved either to long-term storage or to disposal facilities.

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# Integrating Reviews

## *IAEA to launch new review service for radioactive waste and spent fuel management, decommissioning and remediation*

Two IAEA departments involved in radioactive waste and spent fuel management have joined forces to develop and launch a new integrated review service for radioactive waste, spent fuel, decommissioning and remediation of sites contaminated by radioactive materials.

The new service will be based on a clear structure, mechanism and procedures for implementation between the Nuclear Fuel Cycle and Waste Technology Division of the Department of Nuclear Energy, and the Division of Radiation, Transport and Waste Safety of the Department of Nuclear Safety and Security.

So far, each Department provided its own description and scope of services as well as instructions for applying. This duality created some confusion among the Member States as to which service to select and how to apply for it. This was not only disadvantageous for Member States, it also affected the efficiency of the work of the IAEA staff.

**Focus and Method**

The scope of the new review service includes issues related to radioactive waste, spent fuel, remediation and decommissioning. Reviews may focus on national frameworks, regulatory systems and different aspects of national programmes.

They may also involve detailed assessment and technical advice on implementing specific programmes and project, with an emphasis on technology or on safety, or both. The extent to which the focus of the Review is on appraisal or peer discussion will be determined during the development of the specific Terms of Reference:

- Appraisal will involve checking the consistency of activities and procedures against the IAEA safety standards and technical guidance, as well as with good international practice, and identifying areas to improve.
- Peer-to-peer discussion will involve advice through an in-depth dialogue among senior experts from the host organization and the IAEA Review Team.

**Why apply for an IAEA Peer Review?**

The main purpose of the IAEA Peer Review Service is to deliver, upon request, expert advice to the counterpart. Benefits of such a review could include:

- Improved organizational performance relating to the issues under review;
- Enhanced safety, optimized operations and reduced costs;
- Improved confidence of stakeholders, including the public;
- Assessment of national programmes vis a vis national policies and strategies; and
- Improved information made available to strengthen decision making processes.

More information about the new Peer Review Service will soon be available on the IAEA website and in the brochure on IAEA Review Services for radioactive waste and spent fuel management, decommissioning and remediation.

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*An IAEA expert team reviewed Japan's plans to decommission the Fukushima Daiichi Nuclear Power Station in April 2013. Here, Team Leader Juan Carlos Lentijo speaks to workers in the Emergency Response Center of the facility. (Photo: G.Webb/IAEA)*

# Building Capacity

## *With the Internet + Research Reactors*

Since the 1940s, when the University of Chicago hosted the world's first nuclear reactor Chicago Pile-1 (CP-1) strong links have existed between education and training organisations and research reactors. Today's technology allows a Jordanian student to interact with a research reactor in the US, using the Internet.

Many of the over 240 currently operating research reactors are either hosted on college or university campuses or predominately used for education and training purposes. They are vital for the medical, industrial and scientific sectors, but education and training is their most frequently listed application, according to the IAEA Research Reactor Database. Used with classroom lectures, simulators and now with E-learning techniques, research reactors provide unique experiences to students.

Since 2009, the Eastern European Research Reactor Initiative (EERRI), a coalition of reactors from Austria, the Czech Republic, Hungary and Slovenia, has been offering a practical Group Fellowship programme for new graduates and other technical experts with little or no specific nuclear experience.

The six-week programme includes many practical exercises on reactor theory, utilization and operation. It culminates with the actual operation of a reactor. At least three host reactors are involved in each course.

To date 45 students have been trained; at the time of printing of this Newsletter, nine more were planned to join the seventh batch. The course and the EERRI initiative were developed within a regional IAEA Technical Cooperation (TC) project and fellowships are supported using TC as well as Peaceful Uses Initiative (PUI) funding.

The IAEA's PUI funds are also used to expand the fellowship and coalition concept to other regions. An August workshop in Kuala Lumpur looked into such cooperation among research reactors in Malaysia, Indonesia, Thailand and Vietnam. The five IAEA lecturers led practical, hands-on training sessions to supplement classroom lectures. Asia-Pacific Economic Cooperation (APEC) supported other expert lecturers.

In 2010, the IAEA deployed an international internet reactor project using funds received from the USA, and in cooperation with the Jordanian University of Science and Technology (JUST) and the Jordanian Atomic Energy Commission (JAEC).

The Internet Reactor Laboratory (IRL) links an operating reactor at North Carolina State University (NCSU) in the USA with students at JUST and JAEC. Via video conferencing equipment and web-based data transfer, students and local instructors can interact directly with reactor operators as well as an NCSU instructor.

*Students take part in a hands-on training exercise during the EERRI Group Fellowship course at the TRIGA research reactor operated by TU Wien's Atominstitut. (Photo:IAEA)*

The IAEA is using PUI funds to expand the concept to South America, Europe and Africa. These IRLs are being developed around host reactors such as RA-6 in Argentina and ISIS in France.

A December 2012 cross-cutting Technical Meeting organized by the Division of Nuclear Power and the Division of Nuclear Fuel Cycle and Waste Technology, both within the IAEA Department of Nuclear Energy, discussed the role of research reactors in nuclear power related capacity building.

Participants agreed that research reactors, especially lower power facilities with more flexible operating schedules, offer unique capabilities for practical experiments and exercises. They also concluded that while a research reactor is not a prerequisite for a country to develop nuclear power, access to research reactor capabilities, possibly in another country, is almost always part of such a programme.

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# Closing Down

## *IAEA supports Uzbek research reactor decommissioning plan*

The Russian Research Reactor Fuel Return Programme (RRRFR, see next article for details) caused the final shutdown and subsequent decommissioning of some research reactors. Uzbekistan's IIN-3M is one of them. Defueling and transporting its HEU fuel to the Mayak reprocessing facility in Russia is planned to be completed by the end of 2013. Operated by JSC Foton and administered by UZELTEXSANOAT in Tashkent, this is a pulse type, homogenous reactor with liquid HEU fuel. The USA and Uzbekistan asked the IAEA to assist with developing the decommissioning plan for the reactor.

At their first planning meeting in May 2012, the counterparts agreed that the overall decommissioning plan should cover three main activities:

- Programme for defueling and transport of liquid nuclear fuel to Russia;
- Development of a decommissioning plan in accordance with IAEA Report № 45 (2005) 'Standard Format and Content for Safety Related Decommissioning Documents';
- Development of a removal programme of gamma sources from two irradiation facilities at the reactor site.

*IIN-3M reactor vessel, Tashkent, Uzbekistan. (Photo: JSC Foton)*

The IAEA established a working team including experts from the Czech Republic, Russia, the UK and staff from NEFW's Waste Technology and Research Reactor Sections. Staff from JSC Foton, the Institute of Nuclear Physics in Tashkent and Uzbekistan's nuclear regulator also attended the five working meetings in Vienna and in Tashkent.

*A 3D model of the IIN-3M research reactor. (Photo: JSC Foton)*

Initiated in August 2012, the decommissioning plan was fed with data and information from physical and radiological characterization activities. The IAEA helped develop a specific code, called CERREX (Cost Estimation for Research Reactor Decommissioning in MS Excel), to estimate costs.

Immediate dismantling, deferred dismantling and in-situ entombment were the three decommissioning strategies considered. Cost estimate has indicated the immediate dismantling to be the optimum way forward.

The final Decommissioning Plan was handed over to Uzbekistan in June 2013. It establishes general provisions and describes major requirements for decommissioning operations, most significantly from the viewpoint of safety and complexity. It foresees that the reactor site will be restored to a green field and may be further utilized as the Government would deem appropriate. This plan shall be used as groundwork for future, more detailed programmes specific to each decommissioning operation, including project management, waste management, safety and quality assurance activities.

In addition, the IAEA, the Russian organisation ISOTOP, the Institute of Nuclear Physics in Tashkent and JSC FOTON have also developed a plan for removing, packing and transporting radioactive sources from the site to a disposal facility.

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# Going Back Home

## *Vietnam Removes HEU Research Reactor Fuel*

*An IAEA Safeguards Inspector places the secondary seal on the IAEA-owned storage and shipping cask.*

An air shipment in July 2013 made Vietnam the eighth nation to completely repatriate its highly enriched uranium (HEU) research reactor fuel since an international programme was launched 11 years ago. The latest batch of over 11 kg of HEU was contained in spent nuclear fuel (SNF) irradiated in the research reactor at Vietnam's Dalat Nuclear Research Institute, located about 250 kilometers northeast of Ho Chi Minh City. The HEU was flown to Russia, where it will be blended down to a lower enrichment level for use as nuclear power reactor fuel. About four kg of fresh HEU fuel was already transferred to Russia in September 2007 under the auspices of the Russian Research Reactor Fuel Return (RRRFR) Programme.


*Fitting the upper shock absorber on top of the VPVR/M container.*


*Experts ensure there is adequate shielding of the radioactive material.*

The Dalat reactor, which began operation in 1963, was constructed initially as a TRIGA-type reactor, and before its start-up, was reconstructed and commissioned as a Soviet-fuelled, 500-kilowatt reactor. It is used to produce medical radioisotopes, among other research and industrial applications. It was converted to use low enriched uranium fuel (LEU) in 2011.

*Shipment leaves the Dalat Institute.*

The IAEA helped with the arrangements for the 2007 fresh HEU fuel removal, and provided advice on safety and security for shipments completed that year and later in 2013. During the recent HEU SNF shipment, IAEA experts carried out a technical review and provided on-site advice during the preparatory phase.

*Convoy on the way from Dalat Institute to a military airport outside of Ho Chi Minh City.*

In addition, the VPVR/M cask used for the shipment was one of the 10 dual-purpose (SNF storage and shipping) casks the IAEA procured in 2006 with support from the US Department of Energy.

The Skoda cask accommodated all 106 VVR-M2 single type fuel assemblies. It was located at the reactor site into a 20-foot-long ISO container to be transported via public roads to a military airport near Ho Chi Minh City. Placed in a specially designed TUK-145/C transport package, it went on board an Antonov–124 cargo plane for "going back home" to Russia.


*TUK-145/C transport package being loaded to the AN-124 cargo plane.*

**Background**

Under the RRRFR programme that was launched in 2002 by the Russian Federation, the United States and the IAEA, more than 2 000 kg of Soviet-supplied HEU has been transferred to Russia from 14 countries in 53 shipment operations. The IAEA actively supports the RRRFR through a broad range of technical advice and organizational support and by providing training in research reactor conversion from HEU to LEU fuel.

Text & Photos: Sandor Tozser
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# Paying Tribute

## *Franz Dahlkamp: "Uranium Guru"*

*Professor Dr. Franz J. Dahlkamp supported many IAEA Nuclear Fuel Cycle activities over the last four decades. We learned with great sadness that he passed away on 5 March 2013, shortly after attending two Agency meetings.*

*Franz J. Dahlkamp, 1932-2013.*

He was called many names but "Uranium Guru" describes him the best. Franz Dahlkamp's CV read like an encyclopedia. He taught at Universities in Leoben, Salzburg and Munich. While working for Uranerz, a major mining and mineral exploration company, he was part of the team that discovered the Key Lake uranium deposit in Canada in 1975.

Franz Dahlkamp authored the world's best known books on the topic, including "Uranium Ore Deposits" (1993) and a four-volume series he had been working on for the past 20 years. The first two volumes of the "Uranium Deposits of the World" covered Asia (2010), and the USA and Latin America (2012). Over the past few years, he tried to complete the other two on Europe and Australia, carrying large amount of papers with him and engaging in animated discussions with experts on the manuscripts.

He presided over the IAEA's 2009 symposium on "Uranium Raw Material for the Nuclear Fuel cycle: Exploration, Mining, Production, Supply and Demand, Economics and Environmental Issues" (URAM). Held every four to five years since 1970, the next international symposium is planned for 2014.

Prof. Dahlkamp assisted many IAEA Technical Cooperation projects as a lecturer in training courses and as an international expert during field missions.

His most recent activities to assist the IAEA included co-chairing a Technical Meeting on "Classification of World Uranium Deposits with a Focus on Volcanic-related Deposits" and acting as the chair for a series of consultancy meetings to update the uranium deposit classification scheme which the Agency uses in the biennial joint OECD-NEA/IAEA publication: Uranium Resources, Production and Demand. The IAEA classification has become a standard in the industry and the original classification was based on previous input from Dahlkamp and other world renowned experts.

The 82-year-young "Uranium Guru" was an active sportsman. He bought a new pair of skis during this last trip to Vienna and was planning a "skiing mission" in Austria.

Prof. Dr. Franz Dahlkamp will be dearly missed.

Text & Photo: Adrienne Hanly
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**Friends said:**

*"Franz's entire professional life is one big story: he built a vast knowledge of uranium geology and excelled at sharing it in a way that you always wanted to hear more. Being my teacher and mentor for more than 35 years, I benefitted greatly from his analytical and helpful criticism, generosity and continued advice."* Gerhard Rehmann, IAEA consultant

*"Franz was a man with a very strong mind of his own and har to bend. However, he was also a man of enough experience to appreciate the meaning of "compromise" at an international gathering. He knew very well the role and the responsibility of the Agency towards its different members."* Mohamad Tauchid, IAEA retiree

*"I knew him since 1997… He was a very polite, generous, hardworking and respected person."* Reena Thottakkara, IAEA NEFW Team Assistant

# Mining Uranium

## *With an eye on "sustainable" mining, Tanzania hosts Uranium Production Site Appraisal Team*

*Uranium One geologist introduces the UPSAT team to the Mkuju River Site.*

Uranium was first reported in Tanzania in 1954 but systematic exploration started only in the 1970s. Potentially commercial scale activities had to wait until 2007 when the Australian company Mantra started exploration in the Mkuju River area in the south. However, there was an important constraint: The licensed exploration area fell within the boundaries of the Selous Game Reserve, one of the largest in Tanzania and a UNESCO World Heritage Site.

Drilling campaigns proved promising and Mantra saw a realistic prospect of commercialising the resources it had reported. This was also enhanced by a government decision to enter the uranium field to diversify mining activities away from gold, diamond and tanzanite.

The IAEA's initial support to the activity was through a 2012 regional training course on sustainable uranium resources development, held in Dar es Salaam under the auspices of the Ministry of Energy and Minerals (MEM) and Tanzania Atomic Energy Commission (TAEC). TAEC then requested an IAEA Uranium Production Site Appraisal Team (UPSAT) review of the operations and regulation of the proposed exploration and mining projects. This coincided with a transfer of the project ownership from Mantra to Uranium One.

The IAEA's UPSAT programme helps Member States enhance the operational performance and the occupational, public and environmental health and safety of uranium production cycle.

Thus, six experts from Australia, Canada, France and the UK, and two IAEA staff conducted the review from 27 May to 5 June 2013. They interacted with counterparts from the operator, the Ministry of Energy and Minerals, Vice President's Office-Environment, Ministry of Water, Ministry of Natural Resources and Tourism, and from TAEC, the Geological Survey of Tanzania, Tanzania Minerals Audit Agency, the National Environmental Management Council, the Surface and Marine Transport Regulatory Authority and the Occupational Safety and Health Authority. They also paid a two-day visit to the Mkuju River Project site.

The review looked into regulatory, health, safety and environmental aspects, proposed mining and processing designs and flow sheets, stakeholder communication and capacity building requirements for national institutions. The team provided a number of suggestions for harmonising the regulatory system and ensuring that the proposed activities followed IAEA standards and international good practices, especially with regard to health, safety and environmental concerns.

The operator's systematic engagement with local and regional stakeholders was encouraging to see, although the closest village to the proposed mine site was more than 50 km away. The UPSAT team was told that one community leader had asked UNESCO: "Please help us lift ourselves out of poverty by approving this project."

Indeed, in June 2012, UNESCO approved that the mine site would be deemed to be outside the Selous Game Reserve boundary for the duration of mining and remediation activities – a total of perhaps 20 years.

"This was an excellent visit and review, leaving us with a clear road map for the future," said Mr Mrimia D.E. Mchomvu, Acting Permanent Secretary of the Ministry of Energy and Minerals. "We are more confident now in our own capabilities, and look forward to working with both the operator and the IAEA to make uranium mining in

*UPSAT review team, government officials and senior managers from Uranium One at the planned mining site.*

Tanzania a successful and sustainable part of our economic and social development in the coming years." The mission's final report, with observations, good practices, recommendations and suggestions, will be submitted to TAEC in October 2013.

Text & Photos: Harikrishnan Tulsidas
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# Addressing the Legacy

## *CIDER project lays out constraints in decommissioning and environmental remediation*

In many IAEA Member States decommissioning and environmental remediation (D&ER) activities are implemented at a very slow pace or are not implemented at all. Dealing with the legacy from past nuclear practices and avoiding the creation of new legacy sites is an obligation of the present generation arising from ethical principles of social justice and sustainable development. The 7th of IAEA Fundamental Safety Principles is quite specific: "Where effects could span generations, subsequent generations have to be adequately protected without any need for them to take significant protective actions."

*Remediation attempt at uranium waste rock pile in Brazil. (Photo: H. Monken-Fernandes/IAEA)*

At side events to the 54th (2010), 55th (2011) and 56th (2012) regular sessions of the IAEA General Conference, it was suggested that D&ER remained problematic issues for the general public. The IAEA was encouraged to undertake further activities to better understand the global situation, and to establish mechanisms to analyze and report on the constraints impeding the implementation of national programmes. The CIDER (Constraints in Decommissioning and Environmental Remediation) project was created in response.

The IAEA conducted a major survey in 2012 which confirmed that many states have numerous and varied sites and installations that require D&ER. The responses covered all categories of nuclear liabilities and were globally diverse. MS are at various stages of implementation of their D&ER programmes. In general, these programmes are expected to continue to address current liabilities for the next 50 years or more. For the specific cases of D&ER of waste disposal and uranium mining and milling sites, and smaller nuclear remediation sites, shorter timeframes – around 15 years – may be feasible in many cases. These conclusions suggest that there are significant potential benefits to be gained from greater collaboration between programmes, including direct bilateral or multilateral assistance in certain cases.

The CIDER project was formally launched at a March 2013 Technical Meeting involving key Member States with legacy issues and other international organizations interested in promoting D&ER activities on these sites. The Working Groups created met in June 2013 and began a detailed analysis of constraints to D&ER regarding legal, regulatory and policy issues, technical and infrastructure issues, and social and political issues. The analyses will be consolidated into a Baseline Report in 2014, detailing the current global situation and potential solutions for the identified constraints.

It has been recognized so far that financing is undoubtedly a significant constraint to the implementation of D&ER projects. However, without the adequate legal and regulatory framework, appropriate technologies and the supporting infrastructure, including mechanisms for effective stakeholder involvement, little progress can be achieved regardless of the availability of funding. Hence, national and international organizations need to be mobilized to implement the recommendations that will come from the CIDER project. The IAEA will play a key role in bringing the relevant organizations together and fostering the debate around the potential solutions to overcome the elements that constraint the implementation of D&ER in its Member States.

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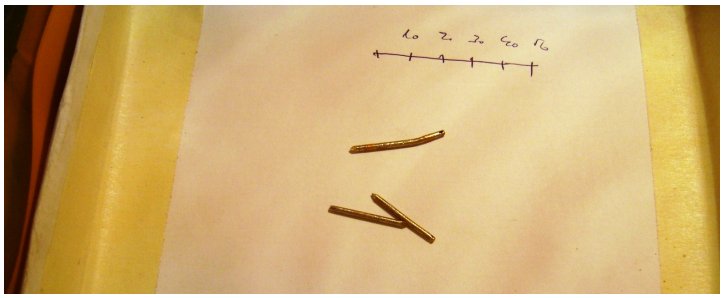
# Managing Radioactive Sources

## *IAEA trains operators in Egypt, recovers source in Sierra Leone*

Radioactive sources are widely used for beneficial purposes every day – in industry, medicine, agriculture and research. However, sources that fall outside effective control pose safety and security risks. To protect the public from the hazards of ionizing radiation, "cradle-to-grave" control of radioactive sources is essential.

The IAEA helps its Member States to increase their own capacity to manage disused sealed radioactive sources (DSRS). A May 2013 training workshop in Egypt focused on pre-treatment, or conditioning, for the safe disposal of radium-226 and other DSRS. The workshop was held under an interregional technical cooperation project (INT9176, Strengthening Cradle-to-Grave Control of Radioactive Sources in the Mediterranean Region), and was organized in collaboration with the Egyptian Atomic Energy Authority (EAEA), with the support from the European Union.

The lectures on cradle-to-grave DSRS management were followed by four days of hands-on practical training on preparing and conducting conditioning operations. In one task, the participants conditioned 12 brachytherapy radium needles with a total activity of 18 mCi (670 MBq) into one capsule, demonstrating their capabilities to conduct such operations. Brachytherapy is an effective method of treatment for cervical, prostate, breast, skin cancer and other kinds of tumors.



*Only 4 cm long, these brachytherapy needles can save lives, but can also cause harm if they fall outside control. (Photo: IAEA)*

*Egyptian operator takes the source out of its container to condition it for safe disposal. (Photo: IAEA)*

*In the absence of an appropriate lead container, the source was placed in an "internal container" that was engineered with available materials and with layers of lead. (Photo: IAEA)*


*Proper labels were put on the final container. (Photo: NSRPA Sierra Leone)*

In urgent cases, or where local infrastructure and human resources are inadequate, the IAEA also provides direct assistance by sending qualified expert teams and mobile equipment to the country and to deal with the problem.

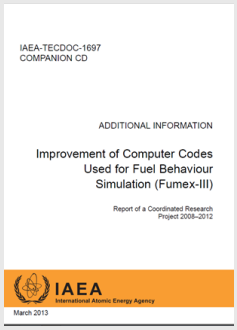
Such was the case in Sierra Leone, when the country notified the IAEA's Incident and Emergency Centre (IEC) in June 2013 that an industrial source (Caesium-137) had been discovered in a home in Freetown, the capital. The Nuclear Safety and Radiation Protection Authority of Sierra Leone had recovered and transported it to its headquarters. When the country requested assistance from the IAEA for recovering and safely managing the orphan source, the Source Management Unit at NEFW's Waste Technology Section was called into action.

Based on the IEC's Assistance Action Plan, including emergency travel arrangements, an expert was already at work in Freetown only four days after the official request. The assistance mission was accomplished by properly conditioning the source, performing a dose assessment and putting it under long-term storage in Sierra Leone.

Juan Carlos Benitez-Navarro

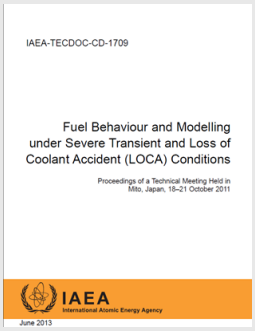
(J.C.Benitez-Navarro@iaea.org)

# Recent Publications



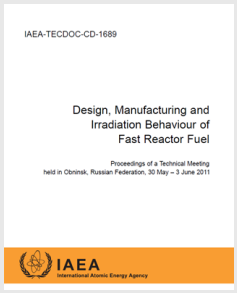

## IAEA TECDOC 1697

Improvement of Computer Codes Used for Fuel Behaviour Simulation (FUMEX-III)
http://www-pub.iaea.org/MTCD/Publications/PDF/TE-1697_CD/Start.pdf



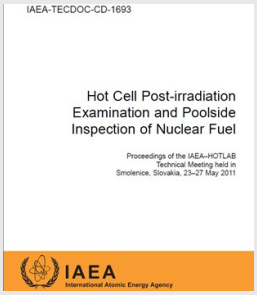

## IAEA TECDOC CD-1709

Fuel Behaviour and Modelling under Severe Transient and Loss of Coolant Accident (LOCA) Conditions
http://www-pub.iaea.org/MTCD/Publications/PDF/TE-1709_CD/Start.pdf



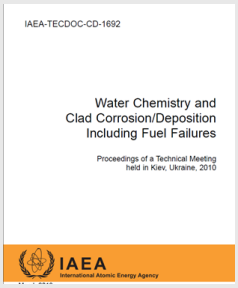

## IAEA TECDOC (CD-ROM) 1689

Design, Manufacturing and Irradiation Behaviour of Fast Reactor Fuel
http://www-pub.iaea.org/MTCD/Publications/PDF/TECDOC-CD-1689/Start.pdf



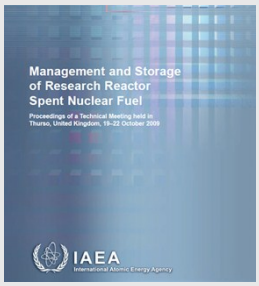

## IAEA TECDOC (CD-ROM) 1693

Hot Cell Post-irradiation Examination and Poolside Inspection of Nuclear Fuel - Proceedings of the IAEA-HOTLAB Technical Meeting held in Smolenice, Slovakia, 23-27 May 2011
http://www-pub.iaea.org/MTCD/Publications/PDF/TE_1693_CD/Start.pdf




## IAEA TECDOC (CD-ROM) 1692

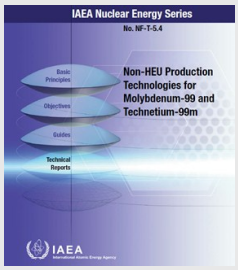
Water Chemistry and Clad Corrosion/ Deposition Including Fuel Failures- Proceedings of a Technical Meeting held in Kiev, Ukraine, 2010
http://www-pub.iaea.org/MTCD/Publications/PDF/TE_1692_CD/Start.pdf




## Proceedings Series - International Atomic Energy Agency

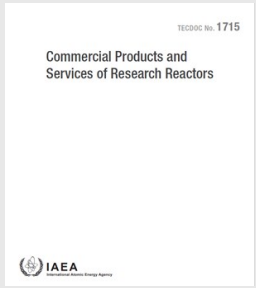
Management and Storage of Research Reactor Spent Nuclear Fuel: Proceedings of a Technical Meeting held in Thurso, United Kingdom, 19-22 October 2009

http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1592_web.pdf



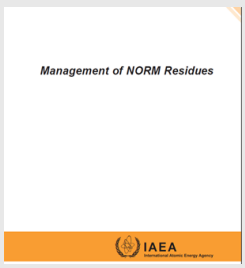

## IAEA Nuclear Energy Series

Non-HEU Production Technologies for Molybdenum-99 and Technetium-99m
http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1589_web.pdf




## IAEA TECDOC 1715

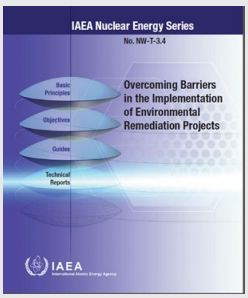
Commercial Products and Services of Research Reactors
http://www-pub.iaea.org/MTCD/Publications/PDF/te-1715_web.pdf




## IAEA TECDOC 1712

Management of NORM Residues

http://www-pub.iaea.org/MTCD/Publications/PDF/TE-1712_web.pdf




## IAEA Nuclear Energy Series NW-T3.2

Overcoming Barriers in the Implementation of Environmental Remediation Projects
http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1602_Web.pdf



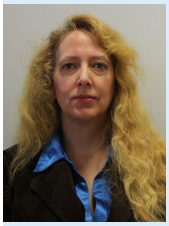
*Click NE News on iTunes App Store*

# Introducing the Authors

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

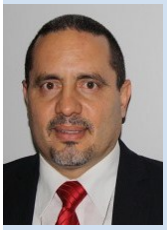
**Greg Webb** is a Press and Public Information Officer in the Media and Outreach Section of the IAEA Division of Public Information. His Section has corporate responsibility for relations with the media and the public.

**Edward Bradley** is the Head of the Research Reactor Section. His background includes significant nuclear power experience including BWR reactor engineering and as an accident mitigation and transient response specialist at the Three Mile Island Unit-1 reactor.



**Adrienne Hanly** is a Uranium Resource Specialist in the Nuclear Fuel Cycle and Materials Section. Her work focusses on aspects of the uranium production cycle and she is the IAEA Scientific Secretary for the Joint OECD/NEA-IAEA Uranium Group.

**Horst Monken Fernandes** is an Environmental Remediation Specialist in the Waste Technology Section. He provides support to Member States on environmental remediation programmes. He is also responsible for the Network of Environmental Management and Remediation (ENVIRONET).



**Juan Carlos Benitez** is a Nuclear Engineer in the Waste Technology Section. His focus is on providing support to Member States upgrading their discussed sealed radioactive source (DSRS) infrastructure and strengthening their technical/operational capabilities to safely and securely manage DSRS.

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

**Susanta Kumar Samanta** is Waste Predisposal specialist in the Waste Technology Section. His work includes characterization, treatment, conditioning and storage of radioactive waste, to enhance waste predisposal operation.

**Pil-Soo Hahn** is the Director of the Division of Radiation, Transport and Waste Safety of the Department of Nuclear Safety and Security.

**Sandor Tozser** works in the Research Reactor Section on matters related to the Global Threat Reduction Initiative (GTRI). His focus is on the Russian Research Reactor Fuel Return Programme, core conversion, spent fuel back end solution, as well as on enhancement of research reactor utilization.

**Tulsidas Harikrishnan** is a Nuclear Technology Specialist in the Nuclear Fuel Cycle and Materials Section. He provides support to Member States on sustainable development of uranium and thorium resources. He is also a coordinator of the integrated Nuclear Fuel Cycle Management System (iNFCIS).

**Patrick O'Sullivan** is a decommissioning specialist in the Waste Technology Section and is Scientific Secretary to the International Decommissioning Network. His work covers planning costing, strategy selection, technologies, and implementation.

**Ayhan Evrensel** is the Communication Adviser of the NE Department. He coordinates the Department's internal and external communication strategies and is the editor of the NEFW Newsletter.

IAEA
International Atomic Energy Agency

# Nuclear Fuel Cycle and Waste Technology

# Upcoming Meetings in 2013

| Date | Title | Place | Contact |
|---|---|---|---|
| 24-27 Sep | TM on Thorium Resources and Provinces | Vienna, Austria | t.harikrishnan@iaea.org |
| 30 Sep-4 Oct | TM on Design and Construction of Very Low, Low-Level and Intermediate-level Waste Repositories | Vienna, Austria | J.faltejsek@iaea.org |
| 7-10 Oct | TM on Uranium Production Cycle Pre-Feasibility and Feasibility Assessment | Vienna, Austria | P.woods@iaea.org |
| 7-11 Oct | TR/WS on Naturally Radioactive Occurring Materials (NORM) | Petten, Netherlands | h.monken-fernandes@iaea.org |
| 14-18 Oct | TM on Condition Monitoring and Incipient Failure Detection of Rotating Equipment in Research Reactors | Athens, Greece | C.morris@iaea.org |
| 14-18 Oct | International Workshop on Research Reactor Ageing, Modernization and Refurbishment | Daejon, Rep. of Korea | E.Bradley@iaea.org |
| 16-17 Oct | TM on Conversion Planning for Molybdenum-99 (99Mo) Production Facilities from Highly Enriched Uranium (HEU) to Low Enriched Uranium (LEU) | Vienna, Austria | R.Sollychin@iaea.org |
| 21-25 Oct | TR on Radioactive Waste Management –Stakeholder Consideration as Inputs into the Strategic Planning for Radioactive Waste Management | Quezon City, Philippines | P.ormai@iaea.org |
| 28 Oct-1 Nov | TM on Modeling of Water-Cooled Fuel Including Design-Basis and Severe Accidents | Chengdu, China | V.inozemtsev@iaea.org |
| 4-8 Nov | RCM on Spent Fuel Performance Assessment and Research (SPAR-III) | Daejon, Rep. of Korea | P.standring@iaea.org |
| 6-8 Nov | 50th Meeting of the Joint OECD/NEA-IAEA Uranium Group | Paris, France | A.hanly@iaea.org |
| 6-8 Nov | TM on Management and Use of Reprocessed Uranium in Water Cooled Reactors | Vienna, Austria | U.basak@iaea.org |
| 12-13 Nov | Annual Forum of the International Decommissioning Network (IDN) | Vienna, Austria | P.osullivan@iaea.org |
| 12-13 Nov | Plenary Meeting of the Network on Environmental Management and Remediation (ENVIRONET) | Vienna, Austria | h.monken-fernandes@iaea.org |
| 14-15 Nov | 12th EPRI (Electric Power Research Institute) Decommissioning and Radioactive Waste Management Workshop– guest meeting | Vienna, Austria | V.michal@iaea.org |
| 18-20 Nov | TM on Advanced Actinide Recycle Technologies | Vienna, Austria | U.basak@iaea.org |
| 19-21 Nov | TM on Development of a Compendium on Good Practices for Utilizing Research Reactors for Education | Vienna, Austria | S.tozser@iaea.org |
| 25-28 Nov | TR on International Low Level Waste Disposal Network (DISPONET) - Workshop on Disposal of Large Volume of Radioactive Waste | Vienna, Austria | P.ormai@iaea.org |
| 25-29 Nov | TM on the Mining and Processing of Uranium and Thorium | Vienna, Austria | P.woods@iaea.org |
| 25-29 Nov | TM on High Burn-Up Economics and Operational Experience | Buenos Aires, Argentina | V.inozemtsev@iaea.org |
| 26-29 Nov | TM on Network of Training and Demonstration of Waste Disposal Technologies in Underground Research Facilities (URF Network) | Vienna, Austria | P.degnan@iaea.org |
| 9-11 Dec | TR on Utilization of High Density Low-Enriched Uranium-Molybdenum (U-Mo) Fuels for RR Operators and Regulators | Vienna, Austria | P.adelfang@iaea.org |
| 9-12 Dec | RCM on Treatment of Irradiated Graphite to Meet Acceptance Criteria for Waste Disposal | Vienna, Austria | m.ojovan@iaea.org |
| 9-13 Dec | TR/WS on Enhanced Role of RRs in Education and Training in Newcomer States Planning NPPs | Vienna, Austria | E.bradley@iaea.org |

**Impressum**

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