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First UPSAT mission takes place in Brazil

A new IAEA service for promotion of best practices and safety in the uranium production cycle, Uranium Production Site Appraisal Team (UPSAT) has been introduced as the uranium production industry continues to expand worldwide. This service is available on request and on a cost recovery basis to any Member State at any facility that is operating in the uranium production cycle (UPC). UPC covers prospecting, exploration, development, feasibility studies, mining, processing, remediation and decommissioning and stewardship in relation to uranium mineral resources.

The Brazilian company Industrias Nucleares do Brasil (INB) have been mining uranium at their site in Caetite, Bahia, since 1999 and decided to seek a peer review of both their current operations and some expansion plans under the UPSAT programme of the IAEA. The terms of reference (ToR) for the UPSAT was negotiated during a pre-mission undertaken by two senior IAEA staff in spring 2009. With the ToR agreed the IAEA set about putting together an team of experts for the review which would provide not only the range of skills and experiences relevant to the ToR but also a more or less global overview of what is current good practice in the modern uranium production industry. The final selection was for a team of 5 (including the IAEA coordinator) from Australia, Canada, the Czech Republic and France who covered areas including radiation and environmental protection, ground

INB Caetite: Uranium mine open pit

Message from the Director

The last year has been a year of change for the IAEA and for the Division of Nuclear Fuel Cycle and Waste Technology (NEFW). In December 2009 Mr Yukiya Amano took over as the Director General of the IAEA. In his early speeches and consultations he has already highlighted the important contribution that nuclear energy can make to global development and has stressed the importance of the fuel cycle and radioactive waste management. 'For those countries which are interested in introducing nuclear power, the IAEA provides assistance at all stages of the process. We have developed basic concepts to ensure that nuclear energy is developed beneficially, responsibly and sustainably.' This puts our work in context. For 2010 the Director General is also highlighting the IAEA's work on cancer. Our Division's contribution covers the production of radioisotopes in research reactors and the removal and securing of sources that have been used for treatment.

The top story in this issue is about the work of a Uranium Production Site Assessment Team (UPSAT) in Brazil. This peer review service, provided by the IAEA, covers both the technical and safety aspects of uranium production and is especially timely in light of the expansion we see in uranium mining around the world. It will continue to be of utmost importance that best practices and experiences are shared in order to avoid future legacies. It is also in this context that we should also see our newest network, the Environet, that will deal with environmental remediation. A third review service that will also become increasingly important is the Waste Management Assessment Programme (WATRP), which we carry out in close cooperation with the Department of Nuclear Safety and Security.

Inside NEFW we have seen quite a large turnover of staff at all levels in 2009. Irena Mele replaced Jan-Marie Potier as Section Head for the Waste Technology Section. Irena was introduced in our last newsletter. Now it is time to welcome Gary Dyck who replaced Chaitanyamoy Ganguly in September. You can read more about Gary and all the other newcomers in the Division on page 14. It is also time for me to say farewell after five very stimulating and interesting years at the IAEA. My successor will be Tero Varjoranta, who is presently working at STUK in Finland. Tero's experience in the different topics we deal with is both broad and lengthy. I wish Tero all the best, and I would like to thank you all for the great support you have given me and continue to give to the IAEA.

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and surface water hydrology, uranium processing, waste management, human resources, management of regulatory requirements, safety and social licensing. The team members each had a long and close association with the uranium mining industry in relation to their specialist skills.

UPSAT team members discussing uranium processing with INB

Before the mission the INB performed a self assessment based on questions from the team. The field mission at Caetite ran from 25 January to 2 February 2010. During this time the team members were able to physically inspect all areas of the Caetite operation and interview key personnel to verify the data provided and to discuss the future plans for changes in mining and processing methods that are being contemplated. The team made a summary presentation of their findings to the senior management of INB at a meeting in Rio de Janeiro on 4 February.

The main findings were that the INB operation is currently well run by a conscientious, well motivated and proud staff. In view of future developments the team made proposals for improvements that INB may wish to consider to reflect good practice from other facilities around the world. These related to: changes in the monitoring system, changes to longer term management of waste; a review of future mine planning; and increasing opportunities fro staff to observe similar operations in other countries. The draft final report was presented to INB in March 2010 for further discussion.

The mission attracted a lot of local interest and media information requests have come in from around the world. Already at least two other uranium production related facilities have made initial approaches with inquiries that could become the next UPSAT missions.

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The Waste Management Assessment and Technical Review Programme (WATRP) Peer Review of a Near-Surface Repository Programme at Saligny, Romania

The IAEA supports its Member States through targeted Peer Review missions that analyze and evaluate the effectiveness and quality of radioactive waste management programmes, systems, and practices. **The *Waste Management Assessment and Technical Review Programme* (WATRP)** is one of the review mechanisms employed by the IAEA, specifically in the area of radioactive waste management. It combines the resources and expertise residing in both the Waste Technology Section and the Waste & Environmental Safety Section in the Department of Nuclear Safety and Security. The reviews are primarily undertaken by an impartial and external panel of experts convened by the Agency and the experts act in a personal capacity, which means that the conclusions present their consensus view. The eleventh WATRP mission was launched in Romania in 2009.

The siting process for a near-surface repository (NSR) for LILW radioactive waste was initiated in Romania in 1992. The Dobrogea region was selected in a regional mapping exercise and the site selection process identified 37 localities as potentially suitable sites. Final preference was given to the Saligny site in 1997, which is very close to the Cernavoda NPP. However, the site selection process slowed down after 1998 due to mostly non-technical reasons and was then restarted after ANDRAD, the national waste management agency, was appointed in 2004 to complete the repository development process. Since this time, ANDRAD has been developing a comprehensive waste management programme.

In response to a request to the IAEA from ANDRAD for a review of its work at the proposed Saligny LILW disposal site, a Peer Review Team was assembled and a 5-day mission conducted in November 2009. The review group comprised four independent experts from France, Canada, and Slovakia. They were supported by two scientific secretaries, one each from the Waste Technology Section and the Waste & Environmental Safety Section. The WATRP Peer Review team had the objective of reviewing technical documentation being developed by ANDRAD to support a submission to the regulator to extend a provisional siting licence for the near-surface repository at Saligny. The Peer Review Team was asked to comment and provide expert advice especially concerning: (i) the characteristics and packaging of the radioactive waste to be disposed of at the site; (ii) the repository design concept; (iii) safety studies; and (iv) siting.

The Peer Review Team held discussions with senior ANDRAD staff, a representative from the regulator CNCAN and managers from the Cernavoda NPP and members from the Nuclear Agency in Romania.

The Peer Review Team further visited Saligny to better appreciate the local site conditions and discuss in detail the field surveys that have been carried out and that will continue into 2010. A local community representative was also met and information was provided by the local experts about how the conceptual design for the repository was being managed to take account of local opinions and the environment.

Geophysical investigations at the Saligny site

The Peer Review then considered the presentations made by the various parties and appraised the supporting documentation for programme quality, efficiency and effectiveness and to ensure that ANDRAD's plans are in line with IAEA safety standards and guidelines and good international practice and contain comprehensive and high quality data and understanding, such as would be expected to satisfy reasonable regulatory requirements. The team then provided preliminary feedback to the ANDRAD senior managers present.

It is clear that valuable, high-quality work has been performed by ANDRAD and its contractors, and there has been significant progress in all areas. the management and staff of ANDRAD are to be congratulated on their efforts and the manner in which they are developing their internal competencies and knowledge base. Notwithstanding this conclusion, the reviewers and senior ANDRAD staff fully appreciate that some challenging issues remain to be dealt with. These are compounded by major difficulties resulting from the current economic climate in Romania and also some significant structural changes in time.

For the future, Romania will need to continue to focus its radioactive waste management efforts, especially if plans for an operational LLW near-surface repository are to be realised at Saligny before the end of the decade. New data are now being acquired through further site investigations and these will continue at least into 2010. Further interpretation of site data and the development of more sophisticated approaches to better reflect the requirements for operational and post-closure safety

assessments will take time and financing. The repository design will be further harmonised with the features of the site to reflect the developing understanding of the natural conditions and how they will likely evolve over the timescale of interest.

Geotechnical investigations at Saligny

The WATRP reviews are a valuable mechanism that can be used by any Member State to identify issues, suggest remedial efforts for any programme deficiencies that might exist or highlight particularly well managed aspects of work. The independent opinions and advice expressed by the panel members may also help to identify gaps in knowledge or provide alternative and more effective ways of achieving goals. Such advice is based on good international practises, personal experience and state of the art methods.

Further information on WATRP Peer Reviews can be found at http://www.iaea.org/OurWork/ST/NE/NEFW/wts_watrp.html

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International Workshop on Post-operational Environmental Monitoring and Surveillance of Disposal Facilities for Radioactive Waste

Disposal of low and intermediate level waste began prior to 1950, and the design of disposal facilities has evolved during this period. Today, internationally accepted designs include trenches with isolation layers for very-low-level waste, near-surface vaults with engineered barrier systems for low- and intermediate-level waste, and, for the same waste category, purpose-built underground caverns at different depths. While the operational aspects of most designs have been mastered in many countries, post-closure experience is limited: most of the facilities are still in operation. It has been generally accepted that surveillance of disposal facilities should continue after termination of operation and facility closure and that an efficient maintenance programme should become a part of the so-called institutional control period. In accordance with the fundamental ethical principle of not imposing undue burdens on future generations, the safety of a closed repository should not rely on active measures. However, adequate maintenance and controls carried out at a repository after closure may enhance its safety. The controls can be active (monitoring, surveillance, inspections), or passive (land use control, record retention, etc.); most should be planned as an appropriate combination of both. As a result, and when justified, corrective actions would presumably be implemented.

The implementation of post-closure institutional measures raises questions regarding practicalities of that phase, duration and optimisation of monitoring, necessary extent of maintenance and corrective actions, role of regulatory bodies, dealing with the public, and other issues. To provide a forum for discussing all relevant issues, the IAEA and ANDRA (France), jointly organized an International Workshop in Cherbourg, France, on 22-25 September 2009, as a part of celebration of 40th anniversary of the opening of the 'Centre de la Manche' disposal facility. The workshop was the first activity of a newly established International Low-Level Waste Disposal Network, DISPONET, aimed at efficient transfer and exchange of knowledge in all aspects of LLW disposal (for more information visit http://www.iaea.org/OurWork/ST/NE/NEFW/wts_DISPONET_homepage.html).

The main objective of the workshop was to share experience and suggest effective concepts for planning, executing, and evaluating active and passive post-closure measures in compliance with requirements to ensure public and environmental protection and taking into account available technologies and economic aspects. Additionally, the workshop was intended to promote information exchange on good practices and approaches for communication among stakeholders.

The workshop focused on surface facilities, but included presentations and posters that dealt also with geological disposal. In regard to the objectives for monitoring and surveillance, workshop participants expressed convergent points of view, in particular: (i) to demonstrate compliance with the regulatory constraints and license conditions; (ii) to verify that the disposal system is functioning as expected; (iii) to strengthen understanding of aspects of system behaviour used in developing the safety case for the disposal facility and to allow further testing of models predicting those aspects; and (iv) to accumulate an environmental database on the site of the disposal facility and its surroundings for future decisions.

The following issues were dealt with:

- Termination of control. In general, repositories are designed to minimize the need for long-term care and maintenance. However, release of the site of a disposal facility for unrestricted use is generally not contemplated, particularly in the case of near surface facilities.

- Understanding of facility performance. More than compliance verification, is the main purpose of monitoring and surveillance. This is the essence of performance monitoring.

- Early planning for monitoring and surveillance. Monitoring and surveillance should be included in the early planning stages for disposal facilities.

- Communicating monitoring and surveillance results. Transparency is served by providing the public with timely and direct access to monitoring and surveillance results including immediate interpretation of results and measurements framework. Means for independent interpretation of the results is a topic for future consideration.

- Optimization of monitoring and surveillance programmes. The programmes need to be reviewed periodically and adjusted as per the outcome of these reviews: safety assessment is a useful tool to be exploited for optimization of a programme.

- Trends in monitoring and surveillance data can show when a disposal facility has reached a long-term stable state.

- Knowledge preservation. Managing information for long term preservation of knowledge is an important requirement for monitoring and surveillance.

- Stakeholder relations and communications. Stakeholder engagement is a life time commitment that is a complex undertaking. Building a balanced social network of interested parties and maintaining the confidence of these parties is a long-term commitment. The stakeholder landscape is one that is evolving continuously.

- Non-radiological contaminants have probably not received enough attention in repository programmes. Going forward, non-radiological contaminants should be given more attention.

About 60 participants form 24 countries and the IAEA took part in the workshop: seventeen technical presentations, four posters and three round tables provided sufficient inputs for discussing all relevant issues. Practical approaches were demonstrated during perfectly organised site visit to La Manche disposal facility which is in a post-closure phase. No surprise that all privies to the event have repeatedly expressed their appreciation to workshop organisers: The role and involvement of ANDRA staff should be highlighted in this regard.

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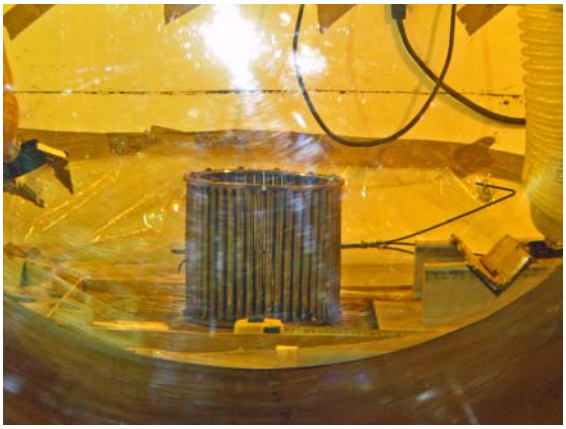
Borehole Disposal of Disused Sealed Sources – Way Forward

Radioactive sources are used throughout the world for a wide variety of peaceful purposes in industry, medicine, research and education. At the end of their useful life, they may still be radioactive enough that they present a potential health hazard, and therefore need to be secured. The principal hazard consists in their external radiation, which requires careful and consistent management practices. Many countries have established their waste management infrastructure and are able to safely condition, store, and in some cases even dispose of the disused sealed radioactive sources (DSRS). There is, however, a large group of countries who have not acquired this capability; these normally have only a small waste management programme. To assist them, the IAEA has contracted Necsa, South Africa, to develop a practical engineered solution, known as the system for borehole disposal of disused sealed sources (BOSS). The BOSS system has four main elements ensuring the safe, secure, permanent and economic disposal of DSRS, namely: (i) recovery and conditioning of sources, (ii) safe, secure interim storage, (iii) containerization of the conditioned sources to form a waste package, and (iv) final disposal in a specially constructed borehole (i.e., the borehole disposal conceptor BDC - see also articles in NEFW Newsletter Vol. 3, No 1 and 2, 2007).

Predisposal elements of the BOSS have already been demonstrated, including remote welding of storage capsule, conditioning of high activity DSRS in a mobile hot cell (Sudan, United Republic of Tanzania), and their transport and storage. Following the non-radioactive demonstration with dummy samples in South Africa, the only country that has launched the BDC development, is

Ghana, and they have completed site screening and geophysical studies at a selected site. This will be followed by subsurface investigations (i.e., borehole tests) planned for this year. The IAEA has been asked to assist some other countries from four continents who are considering using the BDC to dispose of their disused sources.



The above-mentioned developments call for the reassessment of the current BOSS system aiming at better specification of the technical design of particular BOSS elements, their interfaces, and upgrading or developing the relevant equipment. Further to providing services for particular steps of BOSS, this effort aims at the development of a complete technological package to be delivered to interested parties. The package shall consist of a set of procedures and relevant technologies, which might be purchased or temporarily borrowed for the period necessary to manage the disused sources in a country. This assistance should be supported – whenever required – by providing experienced staff to advise in and/or supervise implementing the BOSS system in any of its elements.

The upgrade of the technology will ensure that all disused sealed sources could safely pass through the following steps, even if they require remote operations: (a) recovery from current store; (b) source checking and encapsulation; (c) transport to the centralized store; (d) secure storage; (e) transport to a conditioning facility where it is placed in a disposal container; (f) transport to a disposal facility; and finally (g) disposal.

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Approach to Development of Waste Acceptance Criteria (WAC) for L&ILW

The process for development and formulation of waste acceptance criteria, both preliminary and final, is a key component in waste management The IAEA is developing a new technical document on the definition, development, and establishment of waste acceptance criteria.

The objective of the new document is to provide a background information and advice on the development, implementation and use of radioactive waste acceptance criteria throughout all stages of the waste management. The document will include a brief specification of typical waste package types and relevant processing, handling, transportation, storage and disposal systems for L&ILW. With respect to this, needs for waste acceptance procedures will be determined and principles for their application explained.

In order to collect inputs from the Member States and assemble the first draft document the IAEA held in workshops in Vilnius, Lithuania from 9-13, November 2009 on Approach and Development of Waste Acceptance Criteria for Disposal and/or Storage under the auspices of RATA and Lithuanian Ministry of Energy.

The workshop discussed the issues on the best practices in development and application of WAC for all waste management steps, with a focus on disposal.

The leading presentations were provided by ANDRA-France, Javys-Slovakia, Covra-Netherlands, SKB-Sweden, Enresa-Spain, Germany, NDA-UK, and RATA-Lithuania. Status reports on approach to development of WAC in different Member States were given.

Special focus was on sharing experiences on the methodology for waste acceptance and on the quantitative or qualitative requirements, associated operational parameters and relevant testing or measuring procedures.

In addition brief specifications of typical waste package types and relevant handling, transportation, storage and disposal systems for LILW, as well as links between WAC and Safety Assessment for the different waste package configurations were presented and discussed.

Non-conformity procedures were discussed and adequate formal approach to technical action explained Potential approaches and solutions for the determination of preliminary waste acceptance criteria for countries without a disposal system were also discussed.

The following major suggestions were made:

1. WAC should exist for all stages of waste management and not only for the final waste package that is to be disposed;
2. Although Safety Assessment and Safety Case for storage or disposal facility determine limits especially related to significant nuclides to be declared, activity and dose rate it is not sufficient to determine WAC;
3. Although harmonization related to activity limits, quality of waste form or waste packages, mechanical and handling issues is not possible since it is case

specific the methodology for establishment of WAC could be harmonized.

4. WAC needs to be a living document that would require updating to address specific needs.
5. The treatment of nonconformities needs to be well defined and transparent process that define roles and responsibilities of waste generators, waste processors, operator of storages and disposal facilities and regulators.

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The International Decommissioning Network (IDN) at Three – Active and Curious

Due to the many kind offers from Member States and their organizations to host events in the spirit of collaboration and sharing of experience, 2009 was filled with opportunities for the IDN participants to learn more about specific topics in decommissioning, and to exchange information.

From 1-5 June, 15 decommissioning devotees from 13 countries attended the Argonne National Laboratories' Training Course on the Decommissioning of Small Nuclear Facilities. This course, based on the popular decommissioning course offered regularly by Argonne, provided a complete overview of decommissioning and was offered 'cost free' to the International Decommissioning Network (IDN) for IAEA nominees. Argonne, with generous US government support, brought several of the world's best known experts in decommissioning to Chicago for the week, to lecture and mentor the participants.

The MOATA research reactor

A one-week workshop was organized by the IAEA, in co-operation with Australia's ANSTO, on decommissioning of research reactors and other small facilities from 20-24 July. A MOATA type research reactor was in the process of being dismantled and the 9 participants that IDN was able to send to Sydney with TC cooperation were able to see the hands on work being done up close. Australia plays an active role in the IDN; it is expected that in future they will continue to generously share their growing experience/expertise in decommissioning. In the ANSTO workshop it was possible to discuss details of ongoing and proposed projects in Australia, especially the decommissioning of Australia's large HIFAR research reactor. Through the ANSTO workshop, it is felt that the IDN objective of delivering detailed, hands-on guidance was accomplished. ANSTO deserves a warm thank you for accepting to host the workshop, and for the perfect organization of the event.

From 28 September until 2 October, the UK hosted a Group Scientific Visit to Sellafield and Dounreay. The event was viewed as an important step in facilitating the sharing of knowledge between those with relatively mature decommissioning planning and those new to the process, and to build direct links between those developing their decommissioning plans and those with the skills to assist in carrying them out. The Group Scientific Visit provided the participants with a unique opportunity to observe the planning and technical activities associated with decommissioning on multi-facility sites. The emphasis on detailed planning, safety in all aspects of the work, and the key role played by smaller firms with specialized expertise in implementation was made very evident. The generosity of the two hosts (Scottish Enterprise and UKTI) in investing their time and energy and covering the costs for internal travel and hospitality represented a significant contribution to the IAEA.

In addition to these events, the IDN Annual Forum took place in Vienna from 2-6 November. The meeting consisted of two parts; Part 1 consisted of the annual meeting of the 'International Decommissioning Network' (IDN), and Part 2 consisted of a Special Topical Session on 'Communications with Decommissioning Stakeholders'. These two parts constitute what has become a regular, annual 'Decommissioning Forum', where topics of interest to a broad range of participants from the decommissioning community are discussed.

The annual meeting of the IDN was rich in new ideas brought about by a high degree of participant engagement. The keynote presentations on Innovation and Adaptation of Decommissioning Technology were enthusiastically received at the IDN Meeting. Continued development on this theme builds on the base provided by a recently completed CRP (Coordinated Research Project) on this topic, results of which are published in IAEA-TECDOC-1602. To complement the earlier workshop on waste management and clearance (ENRESA, 2008), a specialist workshop on the application of clearance processes for remaining buildings and site terrain is required and should involve step-by-step development and application of proven

procedures in worked examples to evaluate compliance with release criteria for buildings and sites. Also, tools for practical costing of individual projects are in strong demand for both small and large projects. While a 'bottom-up' approach is preferable when costing decommissioning, to-date most costing of large decommissioning projects appears as a 'black box' process, and that for small projects is performed 'one-off' and with a lot of uncertainties.

The idea of a topical workshop on communication with decommissioning stakeholders being included in the IDN Annual Forum was very well received. It was requested that the format (presentations, visual aids, free discussions and exercise) be repeated in the following years. Such an enthusiastic response had also to do with the fact that the broad content of all presentations does not necessarily apply only to decommissioning but it can be used in other fields such as in environmental remediation and waste disposal. In the words of the participants 'the presentations were realistic and took into account the human factors and values'. This meeting echoed from the first part of the IDN Annual Forum, the importance and need to engage communication among all IAEA Waste Management related Networks. It was clear that these Networks can also assist in the communication with different types of stakeholders. The Networks can be used as a tool to better share experience and information that through other means would not be as efficient.

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Recent Highlights on Re-development of Nuclear Facilities and Sites

Evaluating potential reuse options for decommissioned nuclear sites is an important aspect of the decommissioning process. Early planning for site reuse can facilitate the transition from operation to decommissioning and back to re-use in a timely manner. This process can possibly reduce the financial burden associated with decommissioning, re-employ workers and specialist staff, reduce waste volumes, and alleviate the overall impact of decommissioning on the local community. Conversely, the lack of early planning for site reuse can hinder implementation of a cost-effective decommissioning project. This strategic inadequacy may be caused by insufficient knowledge or experience with redevelopment opportunities that have been exploited successfully in industries elsewhere.

Technical Reports Series No. 444 (2006) provided information and practical guidance on reuse opportunities. It identified the advantages of planning for redevelopment as opposed to traditional decommissioning strategies aimed at site release with no consideration of further use. It also identified roles and responsibilities of all important stakeholders in the site redevelopment process including operators of nuclear facilities, decision makers with the government, regulators/authorities and elected officials at all levels, environmental planners, and the general public. A recently approved Nuclear Energy Series report on Redevelopment and Reuse of Nuclear Facilities and Sites: Case Histories and Lessons Learned is a follow-up to Technical Reports Series No. 444. It provides an overview of decommissioning projects implemented worldwide with reuse of the decommissioned sites for new purposes. The report draws heavily on the experience from the non-nuclear sector, where reuse and redevelopment of former industrial facilities and sites has become mandatory, profitable, or at least fashionable in many countries. It should be noted that reuse of nuclear facilities and sites aimed at decommissioning services or for post-decommissioning purposes is now an emerging trend: the following highlights were made available to the author of the above-mentioned Nuclear Energy Series report after the manuscript was approved for publication, and demonstrate further how former nuclear facilities are being re-used in creative and profitable ways:

1) Oak Ridge has no private small plane airport and the closest one is the one in Knoxville - about 50 km away. Eyed repeatedly over the years, the notion of an Oak Ridge airport has re-emerged now that suitable land is available at a decommissioned uranium enrichment complex. The City Council was asked for its support of a feasibility study for a 1600-m-long airstrip at the former K-25 site.

2) The Graz University Reactor (Argonaut) was dismantled in 2006. It is rehabilitated and used for other functions. In the ground floor there is now a laboratory for welding and in the first floor a flight simulator. The figure below shows the reactor at the beginning of its decommissioning.

3) The decommissioning of Jose Cabrera (Zorita) NPP, Spain, is in an advanced planning phase with some preparatory activities under way. Some buildings are

being adapted to new uses in order to optimize the performance of the decommissioning project. For example, the Turbine Building is transformed into a Dismantling Auxiliary Installation.

Graz University Reactor (Argonaut) prior to dismantlement

4) The Munich Research Reactor FRM-1 went into operation in 1957. It belongs to the Munich Technical University. It was shut down in 2000. Currently it is used as auxiliary facility for its successor and neighbour reactor FRM-2. Due to its peculiar shape (see figure below) FRM-1 is nicknamed 'Atomei' (Atomic Egg) and is protected by the German Law on Monument Preservation.

The Munich Research Reactor FRM-1 or 'Atomic Egg'

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Update on Spent Nuclear Fuel Repatriation Project at the Vinca Institute

In 2002, Serbia was the first IAEA Member State to repatriate fresh (unirradiated) high enriched uranium (HEU) fuel to the Russian Federation under the Russian Research Reactor Fuel Return (RRRFR) programme. It was agreed at the time that the IAEA would also assist Serbia in repatriation of spent (irradiated) nuclear fuel (SNF) from the Vinca Institute RA research reactor.

Given the large number of SNF elements (8030) and the anticipated poor condition of the fuel, it was necessary to repackage all of the fuel to ensure safe transport. This resulted in the largest and most complex TC project in IAEA history with an estimated cost of roughly USD 50 million (50M).

A technician repackaging RA reactor fuel at the VINCA institute near Belgrade, Serbia

The project is currently managed by the Public Company Nuclear Facilities of Serbia (PC NFS) created by the Government in 2009. Recent major milestones by PC NFS include:

- A comprehensive international safety assessment, readiness assessment and FSAR review was successfully completed in July 2009. This milestone led to FSAR approval and licensing by the Serbian Regulatory Authority (SRA) in November 2009 for SNF repackaging and transport. (Special thanks to the Slovenian Nuclear Safety Administration for their in-kind contribution of expert support to the SRA which contributed significantly to making this achievement possible.)

- Agreements successfully negotiated between EU and Serbia resulted in EU extrabudgetary contributions of up to EUR 7.73M for repackaging and transport of the SNF, thereby ensuring sufficient funding to return the fuel to the Russian Federation.

- Commitments were received from Serbia, Czech Republic, USA, Russian Federation, Nuclear Threat Initiative and IAEA to provide a total of USD 24.96M to fund the Foreign Trade Contract for transport within the Russian Federation, SNF reprocessing, and disposition of the resultant high level waste. This led to signing of the Foreign Trade Contract in September 2009 and opened the door to initiate SNF repackaging.

- More than 200 customized fuel repackaging tools and

equipment designed and fabricated by SOSNY R&D Company were delivered to PC NFS throughout 2009; all equipment was assembled, tested and certified for use as of October 2009; all PC NFS operating personnel completed repackaging training as of November 2009.

- A customized water chemistry control system (WCCS) was installed and fully operational as of November 2009. The WCCS minimizes radiation dose rates in working areas of SNF storage pool primarily by controlling specific activity of Cs-137. (Special thanks to an in-kind contribution by the USDOE-NNSA for the customized design and technical assistance.)
- A campaign to reduce project radiation exposures to As Low As Reasonably Achievable (ALARA) was completed successfully in November 2009, reducing the overall project exposure budget by a factor of 4.5 as verified by subsequent real-time repackaging exposure data.
- SNF repackaging began early December 2009; as of the end of Feburary 2010, 2502 fuel elements were successfully repackaged into new transport canisters.

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Returning Spent, Highly Enriched Research Reactor Fuel to the Russian Federation

The IAEA assists Member States participating in international programmes to return research reactor fresh and spent highly enriched uranium (HEU) research reactor fuel to its country of origin. Specifically in support of the Russian Research Reactor Fuel Return Programme (RRRFR) the IAEA published a document on 'Experience of Shipping Russian-origin research reactor spent fuel to the Russian Federation' (IAEA-TECDOC-1632), which provides key information for the planning and shipping of Russian-origin research reactor highly enriched uranium (HEU) spent nuclear fuel (SNF) to the Russian Federation.

The primary goal of the Russian Research Reactor Fuel Return (RRRFR) programme is to advance nuclear non-proliferation objectives by eliminating stockpiles of Russian-origin HEU.

HEU spent fuel shipments have been the most complex shipments under the RRRFR programme, which is the focus of this publication. The first shipment of HEU spent fuel from Uzbekistan was completed in January 2006 followed by HEU spent fuel shipments from the Czech Republic in 2007, Latvia, Bulgaria, and Hungary in 2008 and Kazakhstan and Romania in 2009. The experience obtained from these shipments generated many new ideas and lessons learned that can inform the execution of upcoming RRRFR shipments. The publication discusses these lessons learned, and describes the key steps necessary for the future successful performance of the RRRFR and similar programmes.

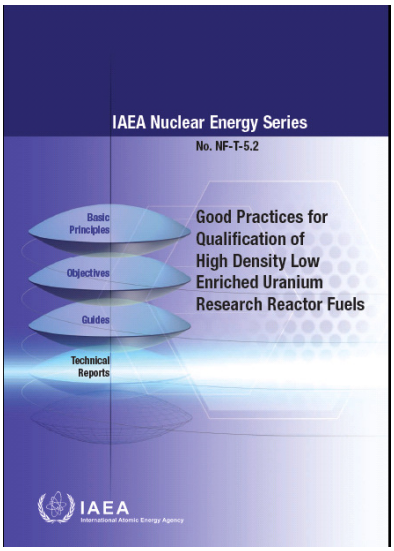
The document provides key information for the planning and return of Russian-origin spent nuclear fuel or materials containing highly enriched uranium (HEU) to the Russian Federation. It is intended for use by all parties involved in the planning, preparations, coordination and operations associated with returning SNF to the Russian Federation. It identifies and discusses the basic methods and activities that serve as the preparatory framework for implementing the programme. It further acts as a valuable resource document by providing the needed forms, procedures, and information to conduct a shipment. With this core information, a shipment plan may be developed by the originating country to identify and organize their specific needs.

Prague Czech Republic – preparing a cask loaded with spent highly enriched research reactor fuel for transport to the Russian Federation

Pablo Adelfang (P.Adelfang@iaea.org)

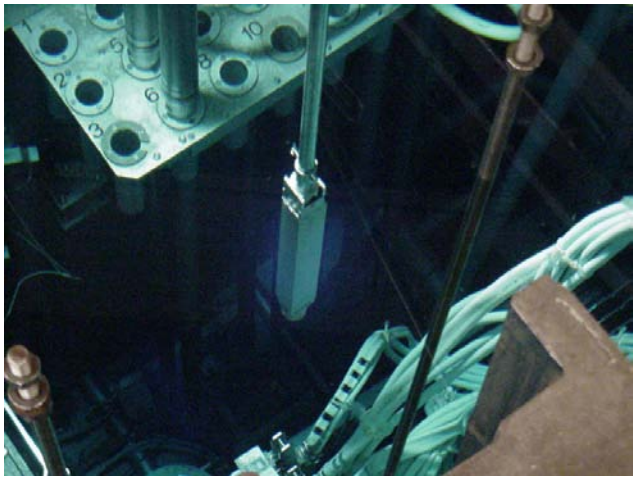
Fuel Qualification

Several national and international efforts are under way to develop, qualify, and license low enriched uranium (LEU) training, research, test, and isotope-production fuel for reactors. This development work, based on use of γ-phase uranium-molybdenum alloys, seeks to provide the fuels needed to extend the use of low-enriched uranium (LEU) to those reactors requiring higher densities than currently available in the uranium-silicide ora uranium oxide dispersions being used in research reactors In addition, uranium-molybdenum alloys are expected to be more easily reprocessed than the uranium-silicide dispersions.



Consistent with increasingly critical non-proliferation concerns brought about by the use of Highly Enriched Uranium (HEU) in training, research, test, and isotope-production reactor fuels, conversion of research reactors from HEU to LEU is acquiring strong momentum worldwide. This implies that an important number of commercial operations involving LEU fuels are foreseeable in the near future. For upcoming LEU fuel supply arrangements, a clear appreciation of the requirements that the procured fuel should meet is crucial. One of the main requisites is that fuels supplied for research reactor core conversion should be qualified. Therefore, a common understanding of what 'qualified fuel' means is mandatory.

To provide points of reference for the type, quality, and completeness of information to be generated in order to ensure the acceptable performance of high density LEU fuels to be used in existing and new training, research, test, and isotope production reactors, the Agency published Good Practices for Qualification of High Density Low Enriched Uranium Research Reactor Fuels (IAEA Nuclear Energy Series No. NF-T-5.2). The information presented in this publication will be of value to fuel developers, reactor operators planning to use a new fuel, and to regulatory bodies faced with deciding whether a specific reactor can be licensed to use a new fuel.



Chilean lead test fuel assembly introduced in HFR-Petten core for irradiation with qualification purposes

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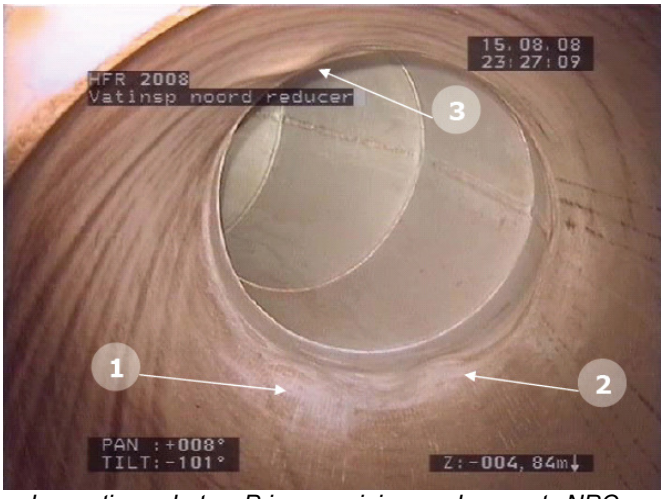
Research Reactor Ageing, Modernization and Refurbishment

More than 50% of all operational research reactors (RRs) are currently over 40 years old; and with increasing age come unique operational challenges. The ongoing crisis related to the supply of the world's most utilized medical isotope, molybdenum-99 (Mo-99), is just one high profile example of such challenges. Since 2007, a variety of issues at Mo-99 producing RRs have led to repeated shortages. The specific issues at the affected reactors are common in that each technical issue has a time (age) dependent aspect to its root cause. Age related operational challenges apply to all RRs and will be a priority for the responsible operating and maintenance (O&M) organizations. To assist O&M managers, the IAEA recently completed a number of activities, published several documents and launched a new database specific to research reactor ageing and operational performance.

In August 2008, IAEA Nuclear Energy Series document NP-T-5.4, Optimization of Research Reactor Availability and Reliability: Recommended Practices, was published. This document provides examples and O&M advice based on the experience of several highly utilized RRs. Eleven unique research reactor O&M management areas are discussed. These include technical topics such as engineering design, maintenance and fuel cycle management as well as non-technical topics including

customer expectations, human resources and public relations management. NP-T-5.4 also contains some information on research reactor ageing. That discussion was further developed in 2009.



Inspection photo: Primary piping reducer at NRG-Petten's High Flux Reactor (HFR-Petten)

In August 2009, IAEA published IAEA-TECDOC-1625, Research Reactor Modernization and Refurbishment. It contains project reports detailing the development, implementation and lessons learned from large scale, engineering modification projects at RRs.

Throughout 2009, further information was collected from individual facilities related to their research reactor ageing experience. Ageing experiences were collected via a simple template and organized by a predetermined list of research reactor systems. A portion of this information was presented during a Technical Meeting in October, 2009 on Research Reactor Ageing, Modernization and Refurbishment. During this meeting, 56 participants from 33 member States presented detailed technical information. Ageing related contributions were compiled into a simple database searchable by system and ageing mechanism. A total of 156 database submittals were received throughout 2009 and the IAEA Research Reactor Ageing database was officially launched during the October Technical Meeting. Technical presentations and contributions to the meeting also included detailed project reports similar to those collected for IAEA-TECDOC-1625. These contributions have been saved for a future revision of that IAEA-TECDOC, pending the collection of additional reports during future meetings on Research Reactor Ageing, Modernization and Refurbishment – currently planned as bi-annual events.

Ed Bradley (E.Bradley@iaea.org)

Fast Reactors and Related Fuel Cycles

December saw the return of the 'Fast Reactor' conference series after an 18-year hiatus. The 'International Conference on Fast Reactors and Related Fuel Cycles - Challenges and Opportunities' (FR09) was organized by the IAEA as a collaborative effort between the Division of Nuclear Power and of the Division of Nuclear Fuel Cycle and Waste Technology, and hosted by the Japan Atomic Energy Agency (JAEA), in Kyoto from 7 – 11 December 2009.

The conference was a huge success, with 622 experts attending from 20 countries and 3 international organizations. There were 150 oral presentations and 154 posters on display. It was opened with a video address from the Director General of the IAEA, Mr. Yukiya Amano.

In the opening session, presenters pointed out that meeting our future energy needs will require rapid expansion of nuclear energy production. They stressed the vital role of fast reactors and associated closed fuel cycles in meeting these needs while minimizing the production of greenhouse gasses, preserving uranium energy resources, effectively managing nuclear waste and reducing the risk of proliferation of nuclear weapons. These themes were echoed throughout the conference, as experts examined the details of the technologies and fuel cycles required to address these goals.

The scope of the conference included such areas as fuels, materials, fuel recycle technologies, advances in simulation capabilities and design of fast reactor components and systems. While reported results were encouraging, remaining open issues were also identified, and R&D programs to resolve them were outlined. The importance of international collaboration in these endeavors was highlighted, as a means to pool resources, avoid duplication, and make best use of synergies.

Looking ahead, NEFW programs will continue to support existing and new fast reactor development programs, to catalyze innovation in fast reactor technologies and to build capabilities in these technological areas by organizing and supporting conferences and meetings of international experts and by coordinating research in the areas of fast reactor fuels, materials and fuel cycle technologies.

For more information see http://www.iaea.org/OurWork/ST/NE/NEFW/nfcms_home.html

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Alexander Stanculescu (A.Stanculescu@iaea.org)

EPPUNE — Stakeholder Communication-related Activities

What is EPPUNE?

EPPUNE stands for Expanded Programme of Public Understanding on Nuclear Energy. EPPUNE was created to facilitate knowledge gathering and experience sharing, and to develop communication skills among the Member States, because science and technology alone cannot fully address stakeholder concerns. The Division of Nuclear Fuel Cycle and Waste Technology (NEFW) and the Division of Nuclear Power (NENP) have planned and organized the implementation of EPPUNE activities. The activities of EPPUNE have been supported financially by the Japanese Government through the Ministry of Economy, Trade and Industry.

EPPUNE activities were first focused on nuclear power, in line with the renaissance of nuclear energy and the need for more information in this field. Because the activities were widely appreciated by the Member States they were extended to include radioactive waste management, decommissioning and environmental remediation. In these latter areas, EPPUNE activities have been implemented in the framework of networks bringing together experienced and less experienced Member States. Networking is a powerful way to promote and facilitate the exchange of experience and information that is essential in the communication process.

Why is stakeholder communication important?

The focus on communication comes from the need to expand public understanding of nuclear energy and associated issues. On a technical level, there are inherent uncertainties that are difficult to assess, while on a social level there are concerns that are difficult to respond to. Through continuous communication with stakeholders, concerns can be identified more explicitly and, on the basis of mutual understanding, issues can be addressed and resolved. Consequently, in the field of nuclear energy, science and technology, communication is an important prerequisite to ensure the legitimacy of technical and societal decision making. Therefore, this combination of supporting public understanding in the context of a robust decision making process contributes significantly to confidence building.

Communicating through networks!

In radioactive waste management, decommissioning and environmental remediation, the need to consider the societal dimension is also evident. The ongoing development of networks within the IAEA is seen as an opportunity to complement workshops and similar activities on technical issues by also addressing issues related to stakeholder communication. Therefore, the thematic networks, such as the URF Network (Underground Research Facilities for High level Radioactive Waste Disposal, established in 2001), the **IDN** (International Decommissioning Network, established in 2007), the **DISPONET** (Low level Radioactive Waste Disposal, established in 2009) and the **ENVIRONET** (Environmental Remediation, established in 2009) are now more engaged in communications.

There is now a growing emphasis on ensuring that technical aspects are combined with societal aspects, hence the relevance of EPPUNE activities.

For further information, please visit:

http://www.iaea.org/OurWork/ST/NE/NEFW/wts_NETWORKS_homepage.html

Mamoru Maeoka (M.Maeoka@iaea.org)

New Staff

Gary Dyck has recently joined the Division of Nuclear Fuel Cycle and Waste Technology as Section Head of the Nuclear Fuel Cycle and Materials Section. He is Canadian and has experience in a broad range of reactor-physics disciplines, working with Atomic Energy of Canada Ltd. He has worked on neutronics calculations for research reactors and has also had experience with nuclear criticality safety analysis and with experimental fuels for power reactors. More recently, he was the head of the Advanced Fuel and Fuel Cycles section where his work on power-reactor fuel cycles included thorium fuels and fuel cycles, inert matrix fuels, advanced fuel recycling technologies, fuel cycles designed for actinide management, and partitioning and transmutation. He has also been involved in the design and development of new reactor concepts. His work on advanced fuel cycles have seen him involved in many international projects over the years, including substantial work with the IAEA as a Member State participant.

Shoichiro Sakaguchi has recently joined the Nuclear Fuel Cycle and Materials Section as a Cost-Free Expert from Japan. He works on matters related to nuclear fuel cycle issues such as proliferation resistant technical features and country profiles and these works will be done as an extra budgetary project. Mr. Sakaguchi joins us from the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan. He has experiences in the management for promotion of R&D in the field of nuclear fuel cycle in Japan. He also served in the secretariat of Nuclear Safety Committee in Japan.

Mamoru Maeoka has recently joined the Waste Technology Section as a Cost-Free Expert from Japan. He works in collaboration with the Division of Nuclear Power on matters related to the facilitation of knowledge accumulation, sharing of communication experience and skill development. He joins us from the Ministry of Economy, Trade and Industry (METI) of Japan. He has experience in the area of nuclear safety and security including communication efforts and nuclear weapon, biological and chemical weapons, missile technology and conventional weapons including their ways of production in terms of security export controls.

Peter Bartsch has recently joined the Nuclear Fuel Cycle and Materials Section as a Uranium Production Specialist. He is Australian and has over 30 years experience in a broad range of extractive industries involving mineral process development and plant design. Peter began his career in metallurgical flowsheet development, and has wide experience with uranium ore testwork, project delivery, as well as process engineering and consulting. More recently, he was an independent consultant where his work on process optimization, process development and feasibility studies covered various uranium and other metal projects. He has also been involved in cost studies and risk reviews of major resource projects. His work on optimizing uranium production has seen him involved in many uranium projects over the years, including substantial work with important production centres at Olympic Dam and Ranger.

Ho Jin Ryu has joined the Nuclear Fuel Cycle and Materials Section as a Cost-free Expert for two years. He is Korean and has worked previously at the Korea Atomic Energy Research Institute at Daejeon as a senior researcher for nuclear fuel cycle technology development. He has experience in fuel cycle research includes DUPIC fuel cycle, fast reactor metallic fuel and research reactor fuel development. He has been involved in IAEA activities as a member of the TWG-NFCO. He was assigned to Argonne National Laboratory in 2005-2007 as a visiting scholar for fuel performance analyses.

Uddharan Basak has recently joined the Nuclear Fuel Cycle and Materials Section. He is responsible for the Advanced Fuel Cycle activities in the Section. He is Indian and has worked previously at Bhabha Atomic Research Centre. He joined BARC Training School in 1977 and has more than thirty years of experience on Uranium, Plutonium and Thorium fuel cycles for thermal and fast reactors. Before joining the Agency, he was the Head, Fuel Development and Manufacturing Section. He was involved in a number of international activities and projects including IAEA activities. He was associated with many professional organizations in India, namely Indian Nuclear Society, Powder Metallurgy Association of India and Indian Ceramic Society.

Recent Publications

IAEA Nuclear Energy Series No. NF-T-1.2
Best Practice in Environmental Management of Uranium Mining (in press) **NEW!**

IAEA Nuclear Energy Series No. NW-T-1.21
Technological Implications of International Safeguards for Geological Disposal of Spent Fuel and Radioactive Waste (2010) **NEW!**

IAEA Nuclear Energy Series No. NW-T-1.20
Disposal Approaches for Long-Lived Low and Intermediate Level Radioactive Waste (2010) **NEW!**

IAEA Nuclear Energy Series No. NF-T-4.6
Status of Minor Actinide Fuel Development (2010) **NEW!**

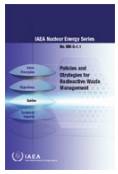
IAEA Nuclear Energy Series No. NF-T-4.4
Use of Reprocessed Uranium: Challenges and Options (2010) **NEW!**

IAEA Nuclear Energy Series No. NF-T-3.5
Costing of Spent Nuclear Fuel Storage (2009) **NEW!**

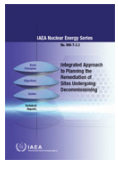
IAEA Nuclear Energy Series No. NF-T-5.2
Good Practices for Qualification of High Density Low Enriched Uranium Research Reactor Fuels (2009) **NEW!**

IAEA Nuclear Energy Series No. NF-T-1.1
Establishment of Uranium Mining and Processing Operations in the Context of Sustainable Development (2009) **NEW**

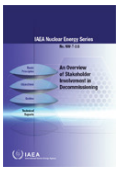
IAEA Nuclear Energy Series No. NF-T-3.6
Management of Damaged Spent Nuclear Fuel (2009) **NEW**



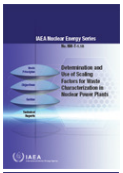
IAEA Nuclear Energy Series No. NW-G-1.1
Policies and Strategies for Radioactive Waste Management (2009)



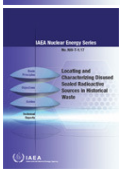
IAEA Nuclear Energy Series No. NW-T-3.3
Integrated Approach to Planning the Remediation of Sites Undergoing Decommissioning (2009)



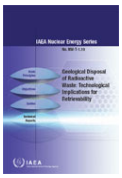
IAEA Nuclear Energy Series No. NW-T-2.5
An Overview of Stakeholder Involvement in Decommissioning (2009)



IAEA Nuclear Energy Series No. NW-T-1.18
Determination and Use of Scaling Factors for Waste Characterization in Nuclear Power Plants (2009)



Nuclear Energy Series No. NW-T-1.17
Locating and Characterizing Disused Sealed Radioactive Sources in Historical Waste (2009)



Nuclear Energy Series No. NW-T-1.19
Geological disposal of radioactive waste: Technological implications for retrievability (2009)

IAEA-TECDOC-1637
Corrosion of Research Reactor Aluminium Clad Spent Fuel in Water (in press) **NEW!**

IAEA-TECDOC-1635
Post-Irradiation Examination and In-Pile Measurement Techniques for Water Reactors Fuels (2009) **NEW!**

IAEA-TECDOC-1630
Use of Reprocessed Uranium: Proceedings of a Technical Meeting held in Vienna, 29-31 August 2007 (2009) **NEW!**

IAEA-TECDOC-1632
Experience of Shipping Russian-origin Research reactor Spent Fuel to the Russian Federation (2009) **NEW!**

IAEA-TECDOC-1629
World Distribution of Uranium Deposits (UDEPO) with Uranium Deposit Classification (2009) **NEW!**

IAEA-TECDOC-1625
Research Reactor Modernization and Refurbishment (2009) **NEW!**

IAEA-TECDOC-1619
Licence Applications for Low and Intermediate Level Waste Predisposal Facilities: A Manual for Operators (2009) **NEW!**

Upcoming Meetings in 2010

Date	Title	Place	Contact
12-16 Apr	TR/Workshop on Multi-scale Modelling for Characterization and Basic Understanding of Radiation Damage Mechanisms in Materials	ICTP-Trieste Italy	V.Inozemtsev@iaea.org
19-23 Apr	Meeting of Waste Management Operators on Benchmarking of Generation, Processing and Disposal of L&IL Operational Waste from NPP (TC RER 3007)	Yerevan Armenia	Z.Drace@iaea.org
26-29 Apr	Plenary Meeting of the Network of Laboratories for Nuclear Waste Characterization (LABONET)	Vienna Austria	A.Morales@iaea.org
27-29 Apr	Annual TWGFPT meeting	Vienna Austria	V.Inozemtsev@iaea.org
18-21 May	TM on Manufacturing Methods for Advanced Nuclear Fuel	Vienna Austria	U.Basak@iaea.org
25-28 May	Regional Workshop on Russian Research Reactor Fuel Return Program Lessons Learned (TC RER/3006)	Poiana-Brasov Romania	P.Adelfang@iaea.org
22-30 May	RTC on Uranium Exploration: management and Regulation (TC RAF/3007)	Malawi	P.Waggitt@iaea.org
31 May-4 Jun	International Conference on Management of Spent Fuel from Nuclear Power Reactors	Vienna Austria	G.Dyck@iaea.org
7-9 June	TM on In Situ Leach (ISL) Uranium Mining	Vienna Austria	J.Slezak@iaea.org
7-11 June	TM on Processing of Waste from Innovative Types of Reactors and Fuel Cycles	Vienna Austria	Z.Drace@iaea.org
7-11 June	TR on Environmental Remediation of Radiologically Contaminated Sites and the IAEA's New EnviroNet Initiative	Illinois USA	H.Monken-Fernandes@iaea.org
8-11 June	Annual TWGNFCO meeting	Vienna Austria	G.Dyck@iaea.org
14-18 June	TM on Assessment of Core Structural Materials and Surveillance Programme of Research Reactors	Vienna Austria	E.Bradley@iaea.org
18-25 June	Regional Training Course on the Conceptual and Numerical Modelling of Sub-surface Processes for Radioactive Waste Management (TC RER/9103)	Albuquerque USA	P.Degnan@iaea.org
5-7 Aug	Coordination meeting on Strengthening Regional Capabilities for Uranium Mining, Milling and Regulation of Related Activities (TC RAF/3007)	Ghana	P.Waggitt@iaea.org
19-23 Aug	45th Joint IAEA-OECD Uranium Group Meeting	Saskatoon Canada	J.Slezak@iaea.org

Impressum

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