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Fuel Cycle and Waste Newsletter

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Division of Nuclear Fuel Cycle and Waste Technology
Department of Nuclear Energy
IAEA
P.O. Box 100
Wagramer Strasse 5,
A-1400 Vienna, Austria
Tel : +43 1 2600 25670
Fax: +43 1 2600 26007

International Conference: Lessons Learned from the Decommissioning of Nuclear Facilities and the Safe Termination of Nuclear Activities

About 350 people from 50 Member States participated in the IAEA-sponsored Decommissioning Conference that was held in Athens, Greece, from 11 to 15 December 2006. The conference provided a unique opportunity to foster information exchange from the increasing number of decommissioning projects worldwide, and thereby promote improved coherence internationally on decommissioning strategies and criteria.

Fort St Vrain, USA. A NPP converted to fossil-fired power plant.

This photo of FSV was taken prior to the construction of unit 4, and shows the stacks of the unit 2 and 3 heat recovery steam generators, located behind the main plant building. The main building houses the old steam turbine and the decommissioned nuclear reactor plant

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The conference focussed on lessons learned from projects that have been completed so far. Major lessons learned were grouped under five major categories, as summarized in the following:

1. Technology

The main activities associated with decommissioning are not necessarily as advanced as the technologies used for the original construction of the plant. They need only to be adequate to achieve the desired objective of decommissioning the site. It has proven to be important to use methods that provide for secure planning and costing rather than other approaches that rely on advanced technology to deliver what in many cases have been shown to be less predictable in their performace and thereby provided lesser potential for cost reductions.

Thus, the lesson of experience is to select techniques that are simple, but fit for purpose, in order to adequately achieve the task, no more, no less. This does not negate the overall need to recognize where a specialist approach is required, and where shortfalls in the applications of simple techniques may warrant the use of the more advanced technologies.

2. Organization (Human Resources)

The proper use of human resources is essential for all projects. Decommissioning activities associated with nuclear facilities share this common requirement. The option to utilize the existing plant operations team has the advantage that the human resource is already there and is familiar with the plant. However, operating and decommissioning activities differ significantly and require a different mentality towards the work.

Nibbler, a simple, inexpensive tool used in cutting activities

There is enough evidence accumulated to note that cooperation between the operating organization (with its site and regulatory experience) and decommissioning experts with clear prior experience of organizing and discharging decommissioning projects is the most effective combination for the success of a decommissioning project. This can be problematic in Member States with limited resources where there are no national alternatives to using the operational staff for decommissioning purposes. External advisors may be needed.

The needs for the reallocation of human resources and their re-training should be carefully appraised considering the various national policies and human resource requirements.

3. Costs

The final costs for decommissioning of large nuclear installations remain difficult to calculate and can be uncertain, particularly in those Member States where decommissioning is a relatively new activity.

These cost uncertainties compound with other factors to make the identification of funding sources very difficult. The difficulty is particularly pronounced if a mechanism for collecting decommissioning funds has not been in place during plant operation. Various national policies on fund development have been developed to suit local requirements. In some, collection of decommissioning funds is given a very high priority. In others, a 'softer' approach including periods of safe enclosure is seen to be a preferable approach, being less disruptive to other national priorities.

Several international working groups are developing standardized decommissioning cost models. However, overall, it appears for many developing countries, decommissioning costs are less than bearable. The consequences of these situations need to be better assessed and appropriate strategies developed.

4. Site Re-Use

Realistic end-states for decommissioning projects vary between projects and sites. If the site is to be re-used for nuclear purposes the required project end-state will be different than if it is to be left as green field or used for other non-nuclear industrial purposes. These factors have to be considered in the definition of decommissioning projects.

5. Strategies

Nuclear regulators in several countries are suggesting that for all intents and purposes, nuclear facilities should be decommissioned immediately following their useful life. This contrasts significantly with the views of the NPP operators, some of which have planned for deferral of final dismantling by as much as 100 years. The absence of final waste disposal facilities makes this debate particularly broad ranging with the need to include consideration on safe long-term storage operations. Until the final disposal facilties are available special considerations should be given to methods for dealing with the wastes arising from decommissioning projects.

Michele Laraia (M.Laraia@iaea.org)

Message from the Director

Dear Reader,

2007 is proving to be a very interesting year for the development of nuclear power. Many countries show interest in investigating if nuclear power is a good option for them. The IAEA is providing support and is also developing documents on the infrastructure needs and setting milestones for different steps towards introducing nuclear power. Supply of fuel and fuel cycle services as well as radioactive waste management are important aspects to consider in this context. Introducing nuclear power means a long term commitment for the operation of the reactors and also for the management of the spent fuel and the radioactive waste. Also, we see an increasing interest in the closed fuel cycle and advanced fuel cycle systems to improve the utilization of the uranium resource while ensuring a high level of proliferation resistance. All these developments involve issues that are dealt with in our Division. In this issue we highlight some of the work performed lately. We also provide faces to the names of the people working in the Division. To get a more complete view of the activities I recommend that you look in earlier issues of the Newsletter that are available on the Web at http://www.iaea.org/OurWork/ST/NE/NEFW/nefw_newsletters.html.

Hans Forsström (H.Forsstrom@iaea.org)

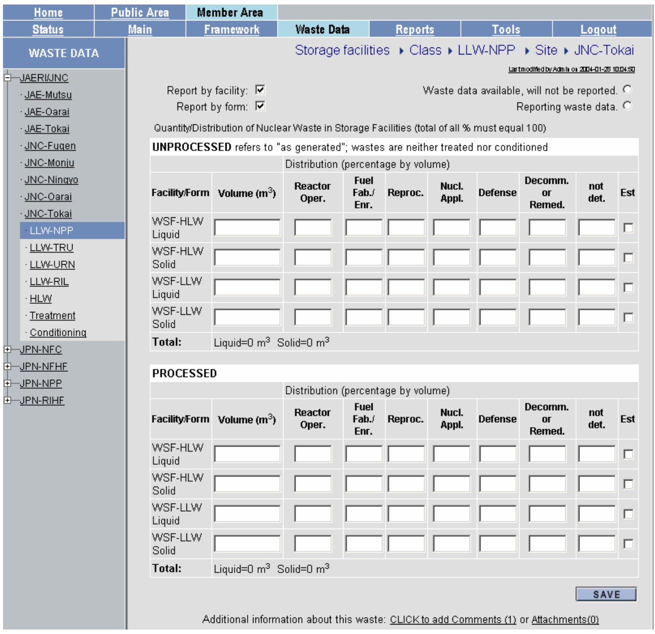
Net-Enabled Waste Management DataBase (NEWMDB): What's Next?

The NEWMDB contains information on national radioactive waste management programmes, plans and activities, relevant laws and regulations, and radioactive waste inventories (both stored and disposed). Version II.2 of the NEWMDB was launched on the Internet in 2006.

For 2007, the IAEA is undertaking a major upgrade of the system for the following purposes:

1) to make it easier to use,
2) to broaden the scope of data collection to enhance its usefulness, and
3) to enable the NEWMDB to be used by our Member States as a tool for reporting under the Joint Convention for the Safety of Spent Fuel and Radioactive Waste Management (the Joint Convention).

In April 2007, Member States will be consulted to develop a Joint Convention reporting tool within the NEWMDB.



Example: NEWMDB Waste Inventory Data Entry Screen. Reporting by facility and waste state (liquid/solid)

Member States that are currently both providing data into NEWMDB and reports to the IAEA under the Joint Convention will be able to benefit from the direct use of their NEWMDB submission information.

All data and submissions will undergo a standard quality control and assurance process to verify that the data are acceptable for public release.

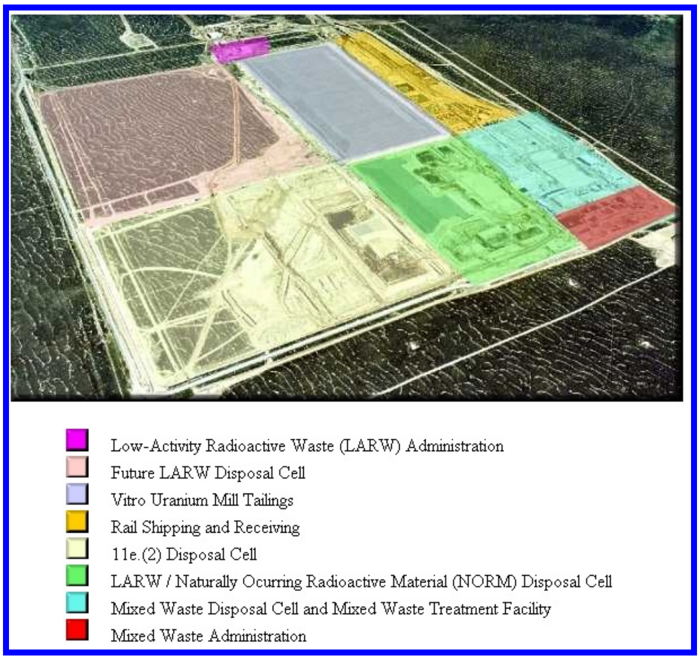
Hence, using NEWMDB directly to assist in the generation of Joint Convention reports will be developed to ensure that provide Member States are provided with:

1) waste-data of high quality,
2) waste-data that are consistent, from a single recognized source, and
3) waste-data that are comparable across all Member States.

Information on the scope of improvements to be implemented in the NEWMDB and progress updates will be regularly posted on the NEWMDB website at

http://www-newmdb.iaea.org/start.asp, and at

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



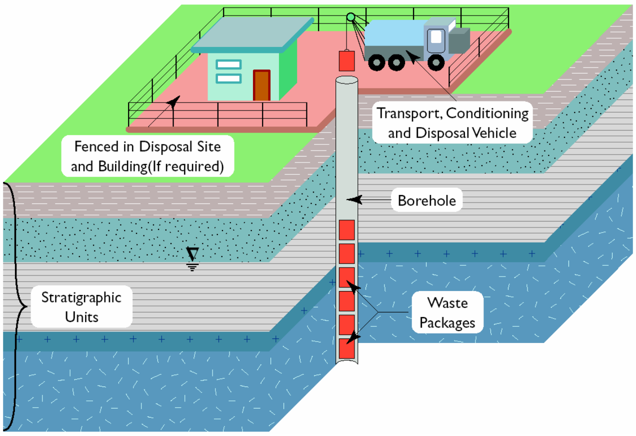
Layout of the EnviroCare of Utah Disposal Site in Clive, Utah, USA – An example of data available in the Reading Room of the NEWMBD

Expansion of the scope of data collection processes required to support the upgrade is being considered. For example, collection of spent fuel data as well as mining and milling waste would be required in order to fulfil the requirements of the Joint Convention. This might prove to be troublesome to a few Member States who do not view these classes of material as 'waste'. Opinions of Member State representatives on topics such as this will be solicited and acted on in 2007.

John Kinker (J.Kinker@iaea.org)

BOSS - (BOrehole disposal of Sealed radioactive Sources)

The ***BOSS*** system is a safe, simple and cost-effective solution for the disposal of disused sealed radioactive sources (DSRS). The ***BOSS*** can be adopted to dispose of small amounts of radioactive wastes.



A schematic view of a **BOSS** System

Seen in the above Figure, the ***BOSS*** consists of:

- A mobile facility that allows even high activity DSRS to be safely conditioned and packed
- A disposal borehole with multibarrier system able to confine safely conditioned DSRS

The sources are placed inside two high integrity stainless steel containers (one inside the other, with expected longevity of thousands of years) and sealed within a 30-100 metre deep, specially engineered borehole in a suitably selected host geological strata.

The ***BOSS*** system provides safety for the current and future generations by (i) isolating the radioactive sources underground so that people will not come into contact with them; and (ii) by using a combination of high integrity stainless steel containers and sealing materials to contain the radioactivity for long enough for it to decay to insignificant levels.

BOSS systems have a number of characteristics that enhance waste safety, cost-effectiveness, and physical security. For example, they:

- Isolate the DSRS from the human environment by placing them underground in high integrity packaging to contain DSRS for thousands of years;
- Provide direct and cost-effective access to a suitable geological environment, using readily available technology;
- Require limited land area and limited infrastructure and short period for ***BOSS*** implementation;
- Have a small 'footprint' minimizing inadvertent intrusion; and
- Require minimal control over the disposal site when the disposal and site restoration have been completed.

The complete ***BOSS*** system – including pre-disposal and disposal activities – can only be implemented in a country if there is a strong national commitment and an independent regulatory system. This could be demonstrated, for instance, simply by a government taking a decision-in-principle to adopt the ***BOSS*** system.

BOSS has been designed to use economic, readily-available materials and technology. The total cost of sealed source disposal in a borehole facility is expected not to exceed US $ 1 million.

The management of disused radioactive sources is the responsibility of the Member State. The IAEA may through its technical cooperation programmes help the State to decide whether ***BOSS*** would be suitable for implementation in their country and, if suitable, what conditions would need to be met. The IAEA may further assist with the deployment of ***BOSS*** through advice, training, reviews and the use of equipment and by providing generic design and safety documentation. At the request of a Member State, the IAEA may consider providing assistance in fund mobilization for the implementation of ***BOSS***. Also, we facilitate the sharing of information and experience in this field and promote regional cooperation between Member States.

More information about ***BOSS*** and the IAEA technical cooperation programmes, can be found on the IAEA Website, www.iaea.org. Alternatively, please contact the IAEA Programme Management Officer in charge of technical cooperation for your country, or Technical Officers at Waste Technology Section.

Bernard Neerdael (B.Neerdael@iaea.org)

Peer Review of the Romanian Project for Low & Intermediate waste Disposal – WATRP Mission

In response to a request from the Romanian national waste management agency, ANDRAD, the IAEA convened a team of five international experts to provide a critical review of activities in Romania relating to site evaluation, suitability of the reference design, and a preliminary safety assessment for the proposed site for a repository for the disposal of Low and Intermediate Level waste. The work was performed in accordance with the protocols established for the IAEA Safety WATRP processes. The review was organised collectively by the Waste Technology Section (NEFW) and the Waste Safety Section (NSRW), and financed through the Technical Cooperation Fund under Project ROM/4/003.

Romanian Experts and IAEA Visitors discussing activities at the Saligny site. Standing on an old drilling platform withCernavoda NPP in the background.

Two IAEA staff members supported five technical experts. These came from the Czech Republic, the European Commission, France, Slovakia, and the United Kingdom. Based on their review of background materials provided by ANDRAD, the experts requested answers to a series of questions from the Romanian experts, who included ANDRAD staff, their subcontractors involved in the siting programme, NPP Cernavoda representatives, the President of the Romanian Nuclear Agency, and representatives of Romanian Nuclear Regulatory Body (CNCAN) and other institutions. The answers were provided during the technical visits to Bucharest and the proposed repository site.

The siting process for a near-surface repository for low- and intermediate-level radioactive waste was initiated in 1992. The Dobrogea region (in eastern Romania) was selected for consideration and 37 potentially suitable sites were identified. Eventually, site investigations and multivariant analyses led, in 1997, to the choice of the site at Saligny, close to the Cernavoda Nuclear Power Plant (NPP).

The site selection process slowed down after 1998. It was re-started after ANDRAD, the national waste management agency, was appointed to complete the repository development process.

The IAEA's WATRP Peer Review focussed on the following:

- The quality of ANDRAD's documentation and technical programme for the development of a the Saligny radwaste disposal project;
- The regulations related to siting;
- Comparison of the Romanian siting approach, with internationally-agreed practices and compliance with IAEA recommendations for repository siting;
- The appropriateness of the technical site investigation programme;
- Comparability of the results site characterisation activities with the siting criteria;
- The conceptual design for the repository; and
- The results of safety studies and their completeness.

Overall**,** the review team found that the site selection programme carried out in Romania so far has been performed in accordance with Romanian national legislative requirements and has respected contemporary international practice and standards. The personnel who have carried out the work were appropriately qualified and technical results were acceptable.

The site appears to be appropriate for the construction of the disposal facility. However, additional information needs to be collected during the next site investigation phase. Specifically, the guidance is that information will be needed for the following purposes:

- to characterize more fully and, thereby, confirm the suitability of the selected site,
- to adapt the design to the particular site conditions,
- to resolve geotechnical uncertainties,
- to provide a more precise characterization of the waste inventory and waste forms, and
- to confirm the repository's long term performance.

This review has been performed quite early in the Romanian siting programme: for example, a request for a site licence is yet to be made. Through this procedure, the advice provided to ANDRAD has the potential to provide maximum effect and benefits the advance of the repository project. This approach should be considered for other national repository programmes.

The Peer Review of this Romanian Project has demonstrated that combined activities of this type, which involve both technological and safety concerns are required to achieve successful and complete outcomes for reviews of Member States' waste repository plans and projects.

Lumir Nachmilner (L.Nachmilner@iaea.org)

Pre-Disposal Activities in 2007

The objective of the activities in the subject of predisposal of radioactive wastes is to strengthen the capacity of Member States to properly and safely process and store waste. Principal foci for the work include the facilitation of the implementation of safe and cost effective technologies in Member States. This is achieved using the normal mechanisms of the IAEA including the following: Provision of general guidance documents (IAEA-TECDOCs); provisions of assistance to individual Member States; and, coordination of research activities of common interest to a number of Member States. The activities are paid for through both the General Budget and the TC-Fund.

In the more recent past, the activites in pre-disposal have looked at the technologies and technological strategies of waste minimization, characterization, treatment, conditioning, and storage. These activities will be continued in 2007 and will lead to the finalization of IAEA-TECDOCs on '*Waste Minimization Considerations at the Design Stage of Nuclear Facilities'* (for both NPP and Nuclear Fuel Cycle Facilities) and on the research results of a Coordinated Research Project (CRP) on '*New Developments and Improvements in Processing of 'Problematic' Radioactive Waste Streams'*. These IAEA-TECDOCs will be published in 2007.

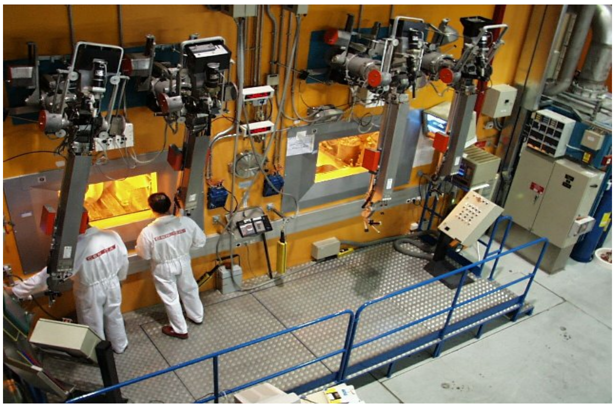
A new CRP on '*Behaviours of Cementitious Materials in Long Term Storage and Disposal'* starts in 2007. This project will establish the state of the art in stabilizing radioactive wastes using cementitious materials. The significant advances that have occurred recently in the application of cement technologies in the non-nuclear industries will be incorporated.

A sorting area for various low-level operational wastes

Based on developments made in previous years the following IAEA-TECDOCs will continue to be prepared for publication in 2008:

- Lessons Learned and Technical Conditions (Requirements) for Radioactive Waste Long Term Storage;
- The Design Requirements for Standardized Simple Storage Structure(s)

  Here, prior development within NEFW for the design of a Modular Design of Low Level Radioactive Waste Processing and Storage Facilities that can be scaled to meet Member States' requirements. Associated contracting processes will be formalised to assist waste managers to facilitate works for their own social and environmental conditions;



Shielded 'Hot' Cells equipped with γ–ray spectrometry bench for characterizing wastes.

- International Experience on the Scaling Factors

  The IAEA-TECDOC will be published in 2008. It is intended to assist Member States in defining methods for converting results from materials sampled from waste streams (including historic wastes) to realistic estimates of the concentrations of materials present in the larger masses.

Work will begin in 2007 to identify and define the benchmarking parameters for liquid and solid waste generated by WWER reactors. The reasons leading to the selection of particular parameters will be identified and an appropriate guidance document will be drafted.

Support will continue for TC projects related either to selection and application of individual predisposal technologies (Slovakia, China, Republic of Korea, Egypt, Brazil, Belarus and Bulgaria) or in support to central processing or storage facilities (Bangladesh, Vietnam, Ukraine, Kenya, Colombia and Lithuania). Human resources capacity will be developed through the provision of regional workshops and training courses on *Quality Management on Radioactive Waste in Central and Eastern Europe*.

Zoran Drace (Z.Drace@iaea.org)

Research Reactor Coalitions and Centres of Excellence

The international research reactor community needs to be poised to meet arising societal needs, especially to support an anticipated 'nuclear renaissance' to satisfy rapidly expanding global energy requirements with carbon-free electricity production, for emerging nuclear medicine technologies, and for many other applications. This requires financially sound institutions, operating under the best practices of safety, security and physical protection, consistent with non-proliferation goals, and on the basis of strengthened regional and international cooperation.

A coalition may be understood through the examples of contemporary air-line alliances or similar cooperative marketing arrangements. They are intended to grow the market through coordinated services, joint marketing by small-scale suppliers while meeting high standards of quality and safety. In other ways, a coalition will provide some functions similar to a trade association in regard to interacting with national governments and other relevant organizations to represent the collective interests of the coalition members.

Once developed, coalitions should be able to coordinate the marketing and sales of participating research reactor services in order to increase the availability of such services to potential customers. They will encourage/facilitate the formation of joint ventures between highly utilized facilities requiring new, lower cost, or regionally sited irradiation capacity with capable but underutilized reactors. The partners will:

- Develop and peer review strategic plans of the research reactors involved, both individually and collectively;
- Offer market analysis and marketing expertise to research reactors that currently do not have access to such skills, both for commercial and scientific/research activities;
- Catalogue and publicize the scientific and technical capabilities of the research reactors in the coalition;
- Develop rational and sustainable costing and pricing strategies, and carry out collective procurements or negotiations with suppliers to receive cheaper prices; and
- Create economies of scale to give groups of reactors more powerful voices commercially and politically and facilitate both fuel supply and 'back-end' solutions.

Initial discussions concerning the possibility of formulating a project on Research Reactor Coalitions began on the margins of the RRFM meeting in Sofia in May 2006. A concept paper was drafted, and the IAEA requested the Nuclear Threat Initiative (NTI) in June 2006 to provide seed funding for an initial meeting to further scope the concept.

Subsequently, the IAEA convened a Consultancy Meeting on 'Developing Proposals for Research Reactor Coalitions and Centres of Excellence' in Vienna from 31 August to 5 September 2006. This meeting reviewed a number of existing international arrangements involving groups of research reactors, discussed the general concept of research reactor coalitions as well as a number of potential subject areas for such work, and reviewed and revised a draft concept paper. This concept paper formed the basis of a grant request submitted by the IAEA to NTI. In October 2006, NTI's Board approved a grant to the IAEA for a two-year project.

The IAEA views this activity as a continuation and deepening of efforts to further integrate its research reactor activities, particularly through the Cross-Cutting Coordinator for Research Reactors. As such, the NTI grant will be coordinated with other IAEA regular, Technical Cooperation, and extrabudgetary funded activities related to research reactor utilization, safety, security, spent fuel management and the fuel cycle, and non-proliferation. The IAEA aims to assist in generating and coordinating ideas, promoting concepts, providing support for meetings and expert missions. Thus, IAEA's role is a facilitator and to a small degree, business incubator.

A work plan for this initiative, including the complementary Technical Cooperation Project RER/4/029, was developed in a consultants meeting in Vienna in January 2007. Progress has already been made in preliminary discussions, including during the European Nuclear Society's Research Reactor Fuel Management meeting in Lyon, France 11-15 March 2007 on a number of 'national proposals' for possible coalitions in Africa, East Asia, Europe, and Latin America involving topical areas including research reactor planning, production of industrial radioisotopes, neutron sciences, and analytical services. A circular note will soon be issued to IAEA Member States inviting research reactor institutions and other related organizations to express interest in participating in a coalition and to submit concrete proposals.

Ira Goldman (I.Goldman@iaea.org)


NEFW Division FEBRUARY 2007
Nuclear Fuel Cycle and Material Section
Hiroko Ratcliffe
Chaitanyamoy Ganguly Section Head
Director's Office
Jobi Murickananickel
Anette Galasinski
Hans Forsström Director
Cornelia Stahl-Feuz
Celine Philip
Waste Technology Section
Jan-Marie Potier Section Head
Emy Awadissian
Zvonko Lovasic
Kaz Stanbridge
William Danker
Management of Spent Fuel from Power Reactors
Research Reactors
Edward Bradley
Ira Goldman
Reena Thottakkara
Pablo Adelfang
John Killeen
Martine Potot-Tarmann
Victor Inozemtsev
Power Reactor Fuel Engineering
FCS Information Systems & Analysis
Jan Slezak
Topical Fuel Cycle Issues
Hidekazu Chayama
Yodit Habtemariam
Mehmet Ceyhan
Jolanta Roch-Braeuer
Hosadu Nawada
Predisposal
Paul Dinner
Zoran Drace
Elisabeth Swoboda
Contact Expert Group (CEG)
Sergey Bocharov
Elizabeth Olentchouk
Waste Disposal
Bernard Neerdael
Lumir Nachmilner
Janet Davies
Malcolm Gray
Decommissioning
Michele Laraia
Horst Monken Fernandes
Peter McIntyre
Romina De Silva
Waste Technology Support/Sealed Sources
Mohamed Al-Mughrabi
Alper Kahraman
Janos Balla
Waste Information Systems
John Kinker
Iouri Pozdniakov
Joseph Neubauer
Shelby Leonard
Robin Heard
Shelby Elamkunnam
Julian Hernanz
Nikolai Efremenkov

Development of Inert Matrix Fuels (IMF) for reducing Plutonium stock-piles:

Reactors around the world have produced more than 2 000 tonnes of plutonium; contained in spent fuel, as separated forms through reprocessing, or as military grade material. The recycling of plutonium as uranium-plutonium mixed oxide (MOX) fuel derives additional energy from this resource; however, it does not effectively reduce the growing plutonium inventories. To reduce the potential risk of proliferation of separated plutonium, several national and multinational research organisations have been devoting R&D works to the transmutation of plutonium in thermal reactors, fast reactors, and advanced systems by utilizing an Inert Matrix Fuel (IMF) concept for the last two decades. IMF is a special type of nuclear reactor fuel that consists of a neutron-transparent (i.e., fertile-free) matrix and a fissile phase that is either dissolved in the matrix or incorporated as macroscopic inclusions. The key difference between a conventional uranium oxide (UOX) fuel and inert matrix fuel is that fertile ^{238}U is replaced with a neutron-transparent matrix which eliminates the plutonium breeding that usually occurs during the irradiation of conventional UOX fuel. Moreover, IMF provides the flexibility to burn down the separated plutonium in the fleet of existing commercial power reactors by slightly modifying the fuel cycle (see Fig. 1 below). IMF could also be used in a 'multi-recycling strategy'. After a last cycle, the spent IMF would be disposed of in a geologic repository.

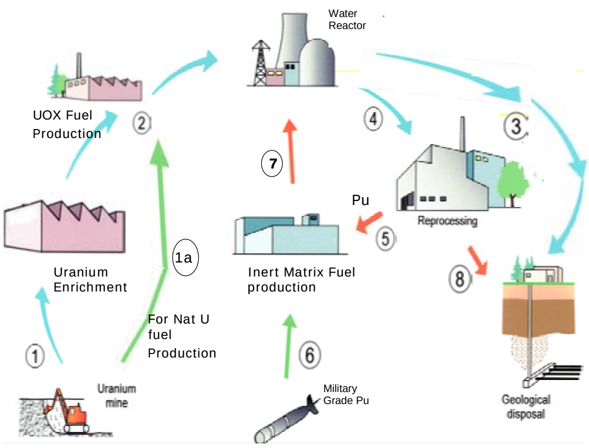


FIG. 1. Nuclear fuel cycle extensions showing both IMF multi-recycling or 'once through then out' (OTTO) options: The arrows (1,2,3) denote the conventional UOX once-through fuel cycle; the arrows (4,5) introduce the reprocessing step where Pu is produced and stocked; arrows (5,7,3) or (6,7,3) represents IMF in OTTO mode and arrows (5,7,4,8) indicates IMF multi-recycling

In this context, the IAEA has prepared a technical document (IAEA-TECDOC-1516, Aug 2006) which reviews the status of potential IMF candidates and describes several identified candidate materials for both fast and thermal reactors: MgO, ZrO2, SiC, Zr alloy, SiAl, ZrN; some of these have undergone test irradiations and post irradiation examination. Detailed studies around the world have produced a number of candidate materials that include stabilized ceramics such as CaxZr1-xO2-x, YyZr1-yO2-y/2, or other ceramics such as ZrSiO4, Y3Al5O12 (yttrium aluminum garnet), MgO or MgAl2O4 (spinel), or even nitrides or carbides. Among these yttria-stabilized cubic zirconia have shown great potential as matrix material. This document also covers some aspects on modeling of IMF fuel performance and safety analysis. System studies have identified strategies for both implementation of IMF fuel as homogeneous or heterogeneous phases, as assemblies or core loadings (see Fig. 2) and in existing reactors in the shorter term, as well as in new reactors in the longer term.

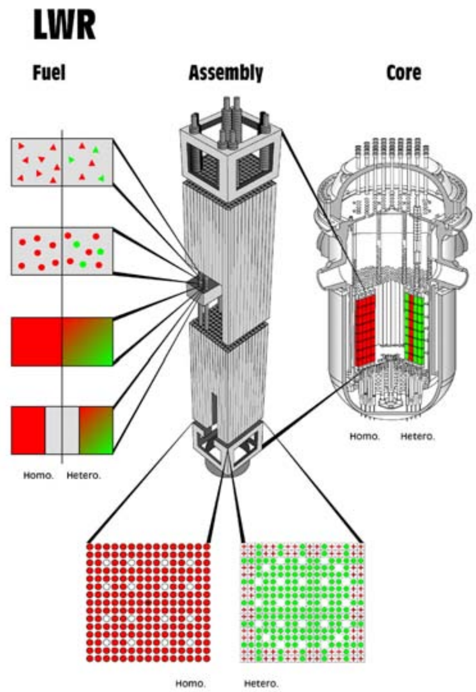


FIG. 2. Different ways of loading IMF into the reactor viz., homogeneous or heterogeneous distribution

The diagram in Figure 2 shows the three levels for IMF use in light-water reactors considering homogeneous vs. heterogeneous system or loading concept at the fuel, assembly, and core levels. The fuel is either a solid solution ceramic homogeneously doped with Pu (red) or heterogeneously doped with some U (green), or is a composite material with particulates or microspheres (again Pu-doped red, U-doped green) imbedded in inert matrix material. The fuel assemblies themselves may be homogeneous (all fuel rods in a given assembly contain IMF, red) or heterogeneous (red IMF rods distributed among green UO2 fuel - e.g. the French Advanced Plutonium Assembly (APA) concept). The reactor core may also be loaded homogeneously (with red IMF assemblies), or the UO2 core may be partially loaded with some IMF assemblies forming a heterogeneous core loading.

This document also summarizes ongoing IMF work and strategies with emphasis on their advanced performance, and application to waste minimization in a closed fuel cycle. The work on IMF to date has established the feasibility and reactor strategies for utilizing these fuels. Commercial deployment is important since IMF can play an important role in the future of nuclear power. Apart from addressing proliferation concern, another important application of IMF is the destruction of minor actinides, with or without plutonium. IMF can be used both to manage plutonium inventories, and to address the long-term radio-toxicity of the spent fuel by minor actinide destruction in current generation reactors. IMF materials are also being considered for Generation-IV reactors. Further development is required before commercial utilization of IMF.

H. Nawada (H.Nawada@iaea.org)

Power Reactor Fuel Engineering

The safe and reliable operation of nuclear fuel is a key issue for the sustainable future of nuclear power and the IAEA has a project of supporting Member States to optimise fuel performance and endurance in operating power stations.

One of the more important areas for fuel reliability is being addressed through the Coordinated Research Project, FUWAC, which is continuing the IAEA's long-standing involvement with Primary Water Chemistry. It is vital to ensure that the primary coolant chemistry is optimised to reduce corrosion of the fuel cladding and to eliminate as far as practicable the deposition of crud on the fuel which can cause problems of power distribution and accelerated corrosion. The first research co-ordination meeting of the FUWAC project was held in Vienna in June 2006, 15 teams from different Member States are participating and they are undertaking a wide range of research projects to investigate the processes operating in the primary coolant. Their common objective is to understand the phenomena leading to corrosion and deposition on fuel, particularly in regard to aging plants which may well have experienced a variety of water chemistry regimes over their lifetimes. With an improved understanding of the fundamental processes it will be possible to provide informed advice to operators on optimising the water chemistry in their particular plant. The research teams are using a wide range of techniques, including autoclave experiments, measurements of the transport of dissolved species and particulates, theoretical studies, and analysis of operational data. The teams are covering all the major types of water reactors; PWR, BWR WWER and CANDU.

A second major focus of the IAEA project on power reactor fuel engineering is to support the computer modelling of fuel behaviour, and there have been many projects in this area, commencing with a first CRP which was completed in 1985. The Technical Working Group on Fuel Performance and Technology (TWGFPT) recognised at its meetings in 2005 and 2006 that there was a strong case to hold a Technical Meeting on fuel modelling that specifically considered the needs of the PHWR community. Many of these countries are less developed countries and their specialists do not often get the opportunity to get together to discuss issues of common concern. The TWGFPT had expressed the hope that this meeting would be the first in an occasional series on PHWR fuel topics to be held in the different countries. The operational parameters of PHWR fuel are very different from those of light water reactors, with significantly higher powers and lower burnups. There is also significant interest in the PHWR community to use slightly enriched uranium fuel with considerably higher burnup capability.

Technical Visit to Tarapur NPP, In the Turbine Hall

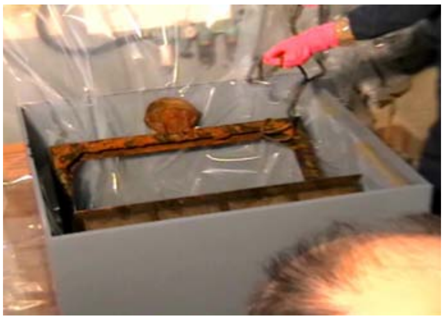
In consequence, a Technical Meeting was held in Mumbai, India on the topic of PHWR fuel modelling and there was participation from all of the PHWR operating countries, Canada, India, Pakistan, Romania, Republic of Korea, Argentina and China. This Technical Meeting was the first to be held by the IAEA devoted to fuel modelling of PHWR fuel and the Indian organisers provided data for a 'Blind' code modelling exercise for a high burnup PHWR commercial irradiation, where PIE information was made available to participants just before the meeting. The meeting was very successful, with 16 papers presented and a good discussion held concerning the blind modelling exercise. The participants were also provided with the opportunity to undertake a technical visit to Tarapur power station.

J.Killeen (J.Killeen@iaea.org)

Spent-Fuel Repackaging Preparations at the Vinča Institute

The Vinča Institute Nuclear Decommissioning (VIND) Program was established to undertake the decommissioning activities and, otherwise, improve waste management capabilities at the Vinča Institute. The Institute of Research on the Structure of Matter (subsequently renamed the Vinča Institute of Nuclear Sciences) was founded at Vinča in 1948 in former Yugoslavia (now Serbia). The Institute is located 15 km southeast of Belgrade and a few kilometres from the Danube River. The leading article of the last Newsletter in this series described the activities being carried out there by the IAEA. This article describes some more specific and recently completed activities.

Overcoming two unforeseen challenges, the project team at the Vinča Institute removed the last of the carbon steel components from the Intitute's spent fuel basin in late February in accordance with the project schedule. This work is a prerequisite for fuel repackaging operations in support of the project to return spent fuel to the Russian Federation under the IAEA's TC project.



Carbon steel component being wrapped with plastic inside a custom storage box

The carbon steel structure and components had to be removed to address sludge accumulation issues as well as to make way for fuel repackaging equipment.

The original plan was to remove the steel from the basin and complete further size reduction in an adjacent work area. However, the surface activity was higher than anticipated. Specially designed and fabricated storage boxes were supplied to house the components. As they were removed, each component was wrapped in plastic and placed inside a custom steel box for storage.

The second challenge came when work progressed to a point where two carbon steel pipes became exposed to view. The pipes had experienced significant corrosion. One of the pipes was completely separated near the water surface and the other was badly degraded. When installed, the pipes had been mounted at the top of the basin and extended nearly to the basin bottom. When the first tube separated, the entire structure shifted and settled slightly to come to rest on the basin floor.

The Vinča team took immediate measures to secure the pipes to prevent them falling further into the basin. A support stand was then developed to cradle the entire structure and facilitate its removal from the basin.

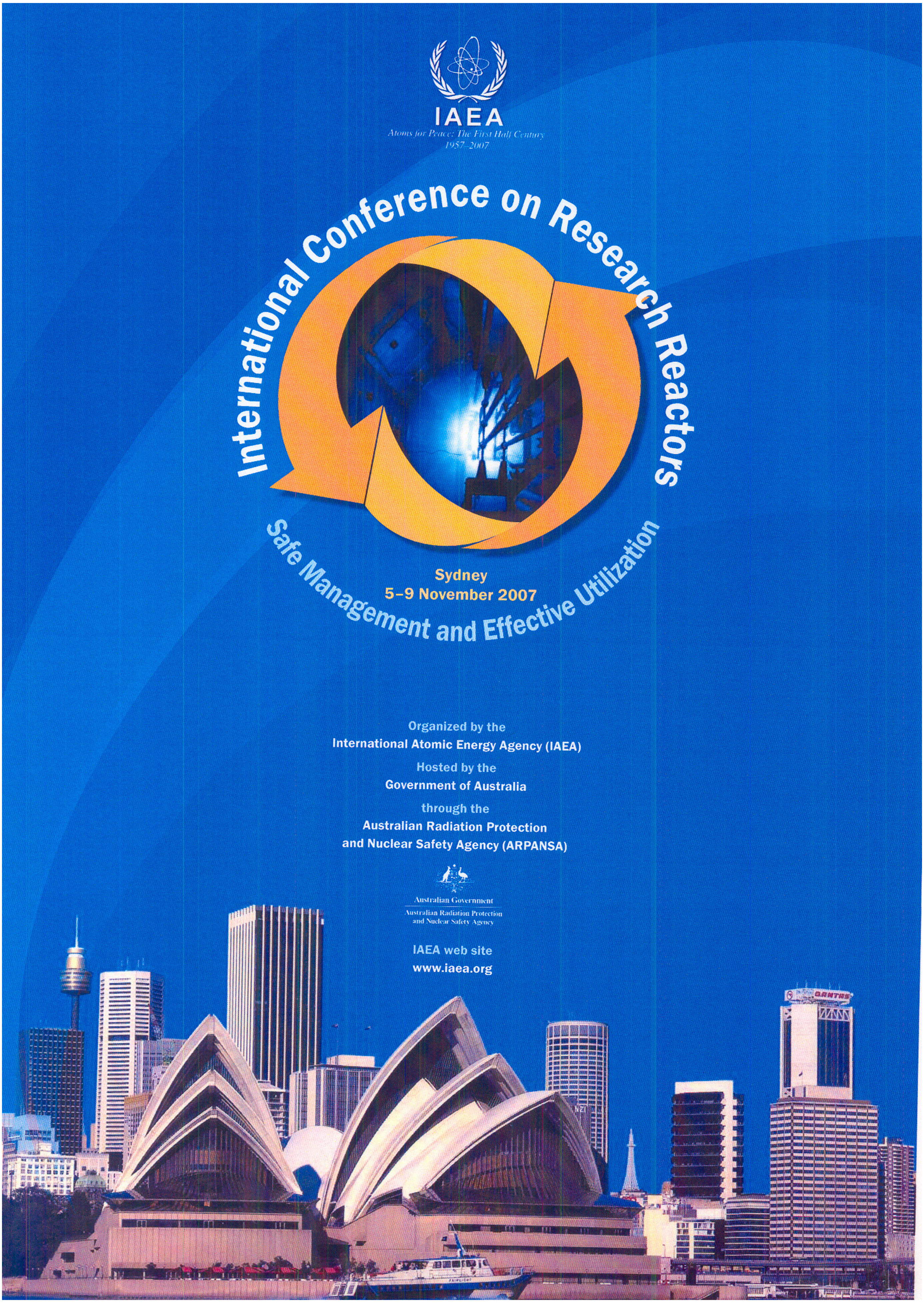
Carbon steel pipes as found in the Vinča spent fuel basin

Carbon steel pipes – top

Carbon steel pipes – removal
Pipe support can be seen along the left side

Poor water chemistry and the presence of carbon steel components have, over many years combined to generate significant sludge in the spent fuel basins. This sludge proved challenging during efforts to remove the carbon steel components discussed above. In accordance with the project schedule, the sludge will also be removed in preparation for spent fuel repackaging prior to shipment.

M. Durst (M.Durst@iaea.org)
P. Adelfang (P.Adelfang@iaea.org)
E. Bradley (E.Bradley@iaea.org)


IAEA
Atoms for Peace: The First Half Century
1957–2007
International Conference on Research Reactors
Safe Management and Effective Utilization
Sydney
5–9 November 2007
Organized by the
International Atomic Energy Agency (IAEA)
Hosted by the
Government of Australia
through the
Australian Radiation Protection
and Nuclear Safety Agency (ARPANSA)
Australian Government
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and Nuclear Safety Agency
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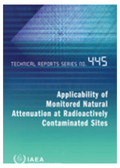
Recent Publications

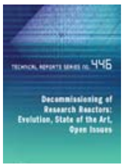
Technical Reports Series No. 442
Remediation of Sites with Mixed Contamination of Radioactive and Other Hazardous Substances (2006)

Technical Reports Series No. 443
Understanding and Managing Ageing of Materials in Spent Fuel Storage Facilities (2006)

Technical Reports Series No. 444
Redevelopment of Nuclear Facilities after Decommissioning (2006)



Technical Reports Series No. 445
Applicability of Monitored Natural Attenuation at Radioactively Contaminated Sites (2006)



Technical Reports Series No. 446
Decommissioning of Research Reactors: Evolution, State of the Art, Open Issues (2006)

Technical Reports Series No. 450
Management of Long Term Radiological Liabilities: Stewardship Challenges (2006)

Technical Reports Series No. 456
Retrieval and Conditioning of Solid Radioactive Waste from Old Facilities (2007)

IAEA-TECDOC-1515
Development of Specifications for Radioactive Waste Packages (2006)

IAEA-TECDOC-1516
Viability of Inert Matrix Fuel in Reducing Plutonium Amounts in Reactors (2006)

IAEA-TECDOC-1518
Retrieval of Fluidizable Radioactive Wastes from Storage Facilities (2006)

IAEA-TECDOC-1519
Data Requirements and Maintenance of Records for Spent Fuel Management: A Review (2006)

IAEA-TECDOC-1521
Characterization, Treatment and Conditioning of Radioactive Graphite from Decommissioning of Nuclear Reactors

IAEA-TECDOC-1523
Optimization Strategies for Cask Design and Container Loading in Long Term Spent Fuel Storage (2006)

IAEA-TECDOC-1527
Application of Thermal Technologies for Processing of Radioactive Waste (2006)

IAEA-TECDOC-1529
Management of Reprocessed Uranium – Current Status and Future Prospects (2007)

IAEA-TECDOC-1532
Operation and Maintenance of Spent Fuel Storage and Transportation Casks/Containers (2007)

IAEA-TECDOC-1534
Radioactive Sodium Waste Treatment and Conditioning: Review of Main Aspects (2007)

IAEA-TECDOC-1535
Nuclear Fuel Cycle Simulation System (VISTA) (2007)

IAEA-WMRA-30
Waste Management Research Abstracts, Volume 30 (2005)

RWM Status and Trends
Radioactive Waste Management – Status and Trends, Report No. 4 (2005)

Radioactive Waste Managem. Profiles No. 7
A Compilation of Data from the Net Enabled Waste Management Database (NEWMDB) (2005)

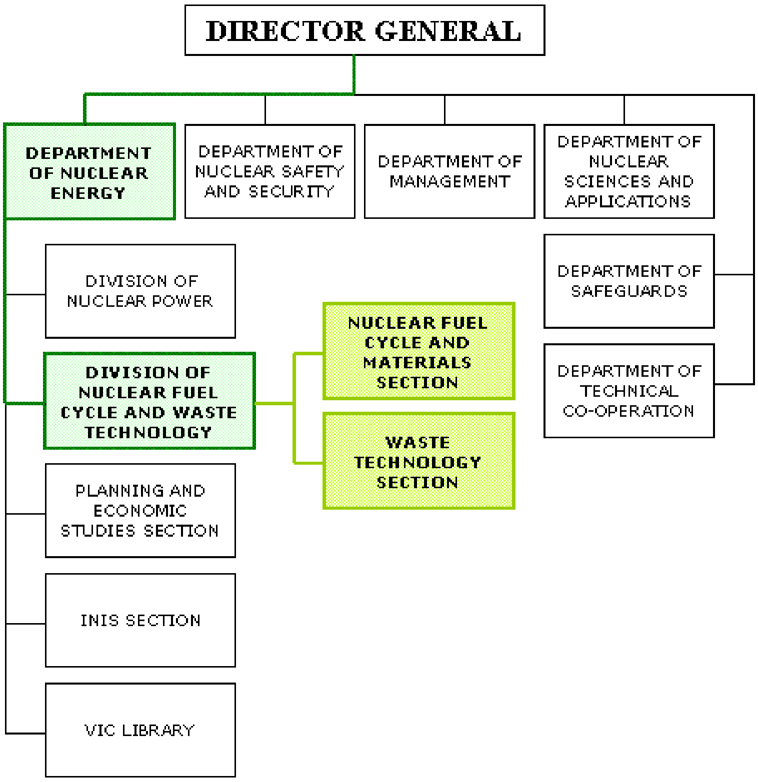
STI/PUB/1259
Uranium Production and Raw Materials for the Nuclear Fuel Cycle - Supply and Demand, Economics, the Environment and Energy Security (2006)

Meetings in 2007

Date	Title	Place	Contact
24-26 April	Technical Meeting on Status and Trends in Water Reactor Fuel Performance and Technology (annual TWGFPT meeting)	Vienna, Austria	V.Inozemtsev@iaea.org
9 - 11 May	Technical Meeting on the Training in and Demonstration of Waste Disposal Technologies in Underground Research Facilities – An IAEA Network of Centres of Excellence	Vienna, Austria	M.N.Gray@iaea.org
14-18 May	Technical Meeting on Review of Sealed Source Designs and Manufacturing Techniques Affecting Disused Source Management	Vienna, Austria	J.Balla@iaea.org
29 May-1 June	International Radioactive Waste Technical Committee (WATEC)	Vienna, Austria	J-M.Potier@iaea.org
19-22 June	Technical Meeting on Uranium Small-scale and Special Mining and Processing Technologies	Vienna, Austria	J.Slezak@iaea.org
25-29 June	40th Joint OECD/NEA-IAEA Uranium Group Meeting	Paris, France	J.Slezak@iaea.org
27-31 August	Workshop to Update Waste Management Information in the Net-Enabled Waste Management Database	Vienna, Austria	J.Kinker@iaea.org
29-31 August	Technical Meeting on Re-use Options of Reprocessed Uranium	Vienna, Austria	H.Nawada@iaea.org
3-5 September	Technical Meeting on Fuel Rod Instrumentation and In-pile Measurement Techniques	Halden, Norway	J.Killeen@iaea.org
17-19 September	Technical Meeting on International Experience in the Determination and Use of Scaling Factors in Waste Characterization	Vienna, Austria	Z.Drace@iaea.org
1-5 October	Technical Meeting on Remediation Strategies for Managing Environmental Liabilities under Constrained Resources	Vienna, Austria	H.Monken-Fernandes@iaea.org
1-5 October	Technical Meeting on Uranium Exploration, Mining, Processing, Mine and Mill Remediation and Environmental Issues	Swakopmund, Namibia	J.Slezak@iaea.org
9-11 October	Technical Meeting on Nuclear Fuel Cycle Options and Spent Fuel Management	Vienna, Austria	W.Danker@iaea.org
29-31 October	41th Joint OECD/NEA-IAEA Uranium Group Meeting	Vienna, Austria	J.Slezak@iaea.org
1-2 November	Technial Meeting on Recent Developments in Exploration Resources Production and Demand	Vienna, Austria	J.Slezak@iaea.org
5-9 November	International Conference on Research Reactor: Safe Management and Effective Utilization	Sydney, Australia	P.Adelfang@iaea.org
12-16 November	Technical Meeting on Lessons Learned by Member States in Using the Catalogue of Sealed Radioactive Sources	Vienna, Austria	A.Kahraman@iaea.org
19-22 November	Technical Meeting of the International Working Group on Research Reactors (TWGRR)	Vienna, Austria	P.Adelfang@iaea.org
19-22 November	Technical Meeting on LEU Fuel Utilization in Accelerator Driven Sub-critical Systems	TBD	P.Adelfang@iaea.org
26-28 November	Technical Meeting on Technical Challenges in Initiating International Ownership of Nuclear Fuel Cycle Facilities	Vienna, Austria	C.Ganguly@iaea.org
26-30 November	Training Meeting on Water Quality Management for Research Reactors	Ljubljana, Slovenia	P.Adelfang@iaea.org
10-12 December	Technical Meeting on Developments in Fuel Cycle in the Transition Phase from Operating to Innovative/Advanced Reactors	Vienna, Austria	H.Nawada@iaea.org

Division of Nuclear Fuel Cycle and Waste Technology WebSite Links

Division Introduction NEFW home: http://www.iaea.org/OurWork/ST/NE/NEFW/index.html



Nuclear Fuel Cycle and Materials Section (NFCMS)

- Main activities
  http://www.iaea.org/OurWork/ST/NE/NEFW/nfcms_home.html
- Technical Working Group on Nuclear Fuel Cycle Options (TWGNFCO)
  http://www.iaea.org/OurWork/ST/NE/NEFW/nfcms_twgnfco.html
- Technical Working Group on Water Reactor Fuel Performance and Technology (TWGFPT)
  http://www.iaea.org/OurWork/ST/NE/NEFW/nfcms_twgfpt.html
- Databases (NFCIS, UDEPO, VISTA, PIE)
  http://www.iaea.org/OurWork/ST/NE/NEFW/nfcms_infcis.html

Waste Technology Section (WTS)

- Main activities
  http://www.iaea.org/OurWork/ST/NE/NEFW/wts_home.html
- International Radioactive Waste Technical Committee (WATEC)
  http://www.iaea.org/OurWork/ST/NE/NEFW/wts_watec.html
- Technical Group on Decommissioning (TEGDE)
  http://www.iaea.org/OurWork/ST/NE/NEFW/wts_tegde.html
- Databases (NEWMDB, DRCS)
  http://www.iaea.org/OurWork/ST/NE/NEFW/wts_information.html

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