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SCIENCE AND TECHNOLOGY WEEK

The nuclear R&D programme of the JRC

EU Science and Technology Week
JRC – China Research Collaboration
Shanghai, 18 June 2010

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Outline of the presentation

- European Commission position
  - on nuclear safeguards & security
  - in the nuclear debate
    - ➜ *see presentation on reactor systems*
- Structure of the FP7 Euratom nuclear programme
- Co-operation China Atomic Energy Authority and EURATOM
- Nuclear research at the JRC:
  challenges and perspectives
- Conclusions

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Nuclear safeguards & security

Nuclear safeguards and security have a long history in the European Union: Euratom Treaty (1957), with JRC to provide S&T support.

Why to address the safeguards/security issue at EU level?

- The EU is essentially an area without internal borders; security is a common concern
- Effective coordination and information flow
- Strong international dimension

EU external borders

- 11,400 km land border

- 75,000 km coastline

- 1,792 external border crossings

EU initiatives with focus beyond EU (examples):

Instrument for Nuclear Safety Co-operation 2007-2013

- to enhance the level of nuclear safety, radiation protection and safeguards of nuclear material in third countries.

Instrument for Stability addresses global and trans-regional threats (2006+):

- To support global and trans-regional efforts to address the threats posed by trafficking, terrorism and organised crime.
- To support international efforts to address the proliferation of weapons of mass destruction, in particular through effective control of CBRN materials, control of dual-use goods,...

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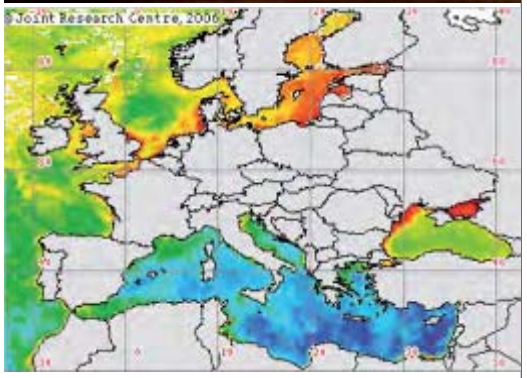
Nuclear research in Europe: the challenges

FP7 EURATOM Program (DG Research & JRC)

- **nuclear safety**
  (includes fuel cycle & Gen IV)
- **nuclear waste management**
  (includes basic R&D, reference data, environment, radiation protection)
- **nuclear security (JRC)**



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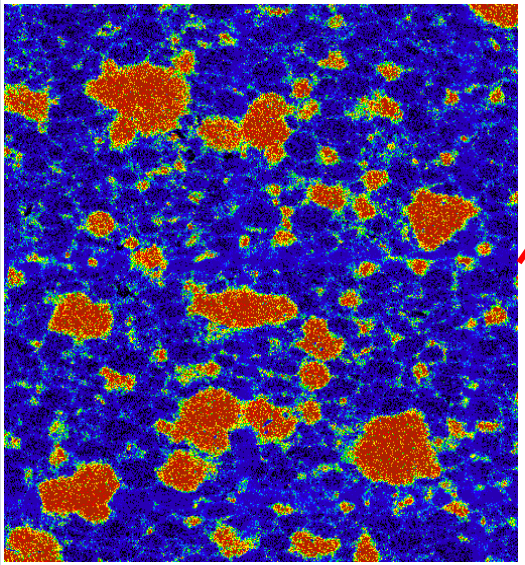
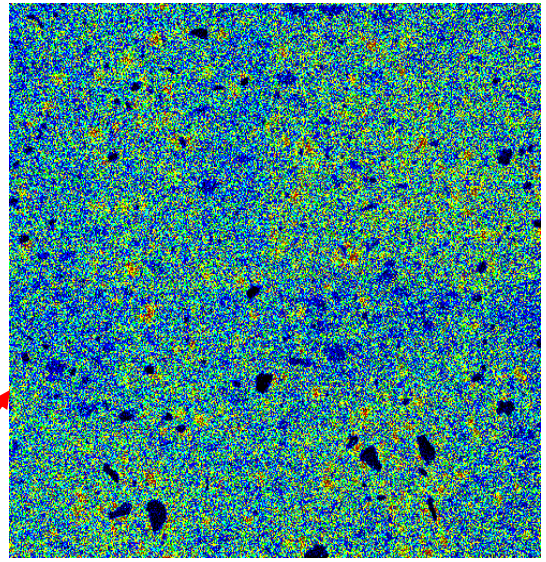
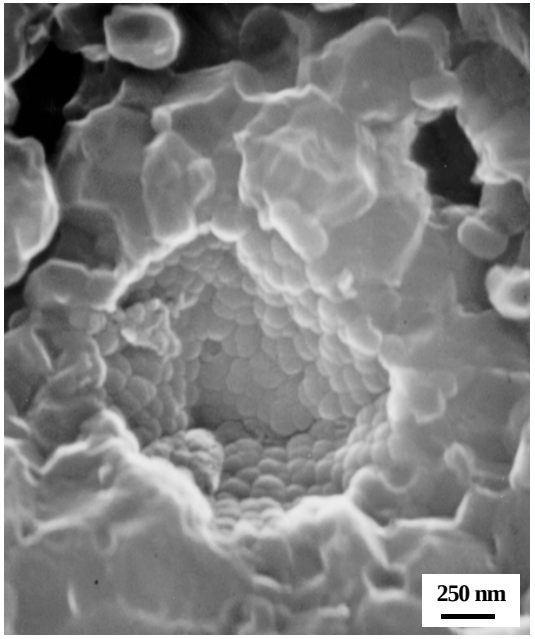
Gen II / III fuel safety: high burn-up studies





MIMAS MOX fuel: Homogenization of Pu clusters via addition of bentonite



Structure at very high burn-up (75 GWd/tHM) at the rim of UO2 PWR fuel (SEM analysis)

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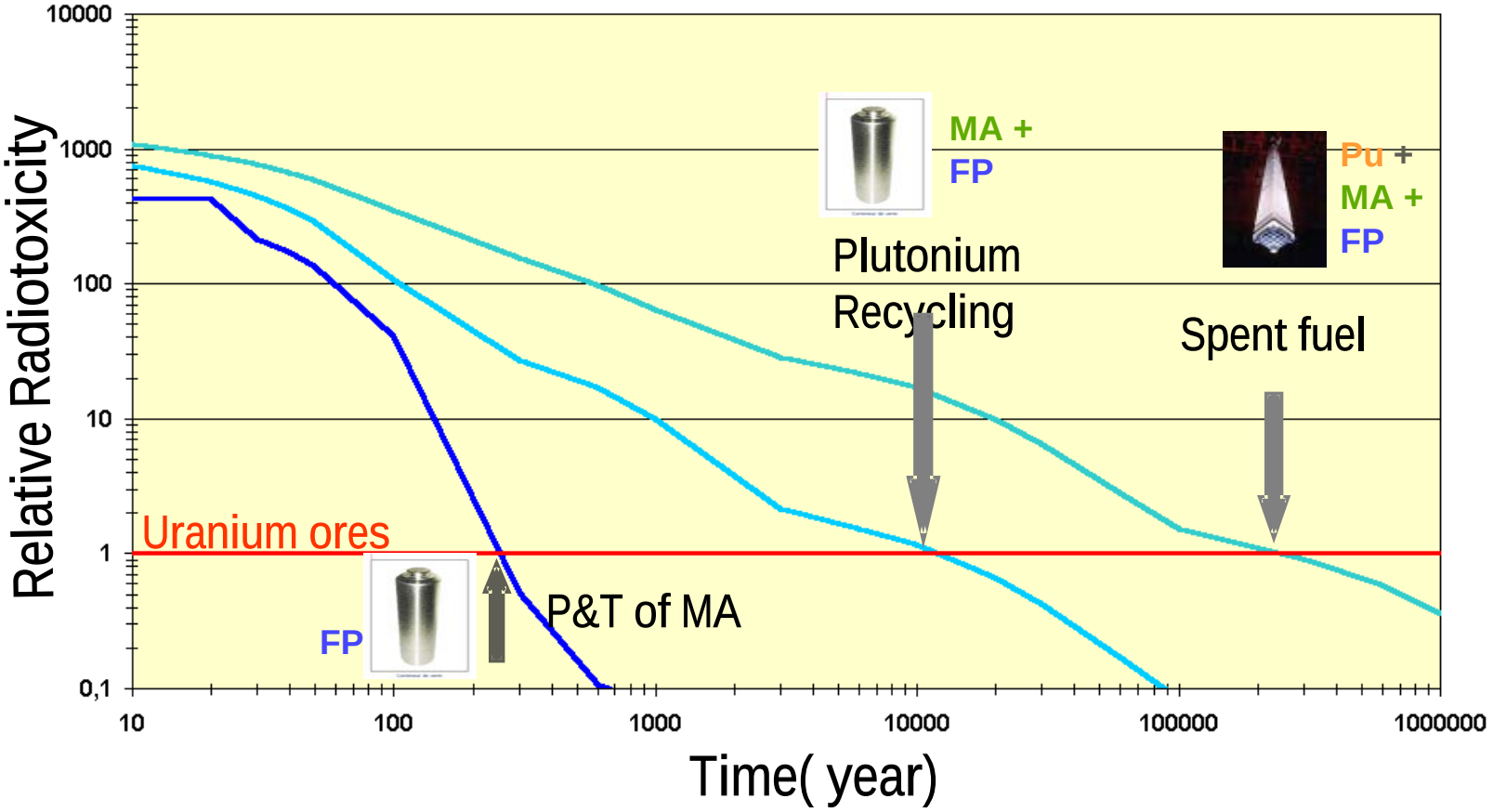
Advantage of actinide recycling

Sustainability, waste minimisation



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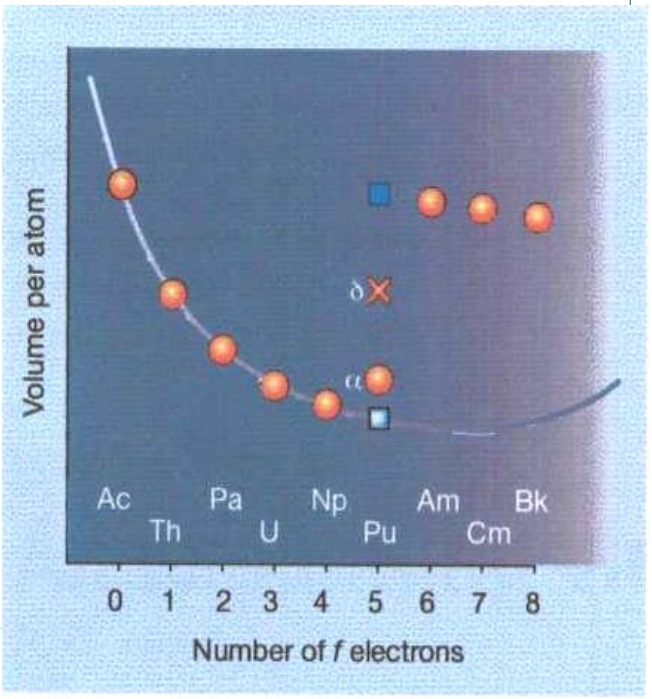
Basic actinide science

- Solid state physics and chemistry of the actinides
- Surface science and interface phenomena
- Co-ordination chemistry in aqueous and non-aqueous systems
- Thermodynamics of the actinides

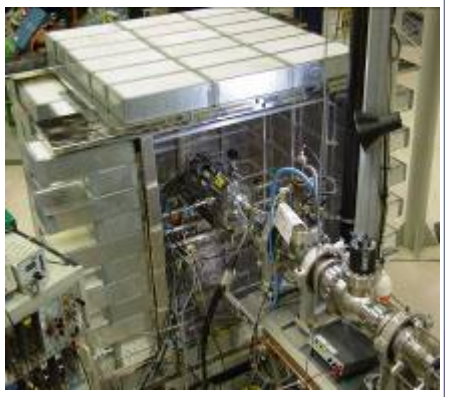
Karlsruhe Nuclide Chart



Accelerator laboratories

Cross-sections measurements

- 150 MeV electron linac produces white neutron spectrum < 20 MeV
- 7 MV van de Graaff accelerator driven quasi mono-energetic neutron source via (p, n) reactions
- Neutron data for modelling:



- nuclear waste transmutation studies
- safe operation of nuclear power plants; modeling of ageing reactors
- understanding safety issues of innovative reactor concepts

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JRC activities in nuclear safeguards & security: support to Euratom and to IAEA

Basis and Objectives:

- verification of declared activities (Euratom & IAEA – NPT)
- verify the absence of un-declared nuclear activities (IAEA – Additional Protocol)

Activities:

- Monitoring environmental radioactivity
- Nuclear reference materials
- Open-source information: Country reports (Web, satellites)
- Combating illicit trafficking, Nuclear forensics analyses

⟶ ***further examples on the next slides***

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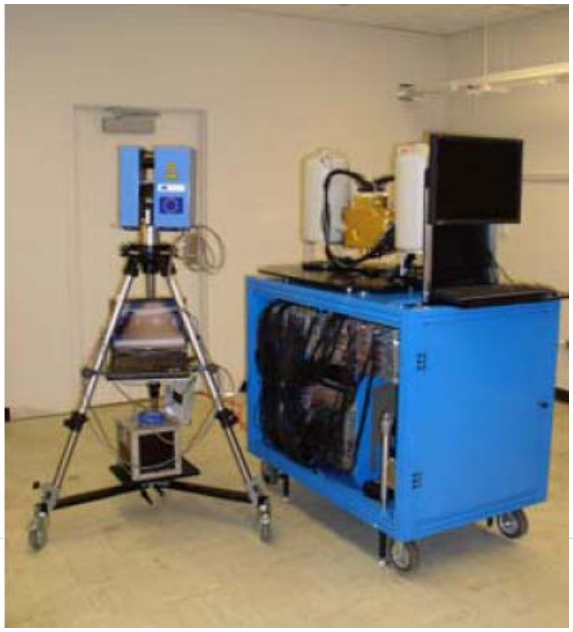
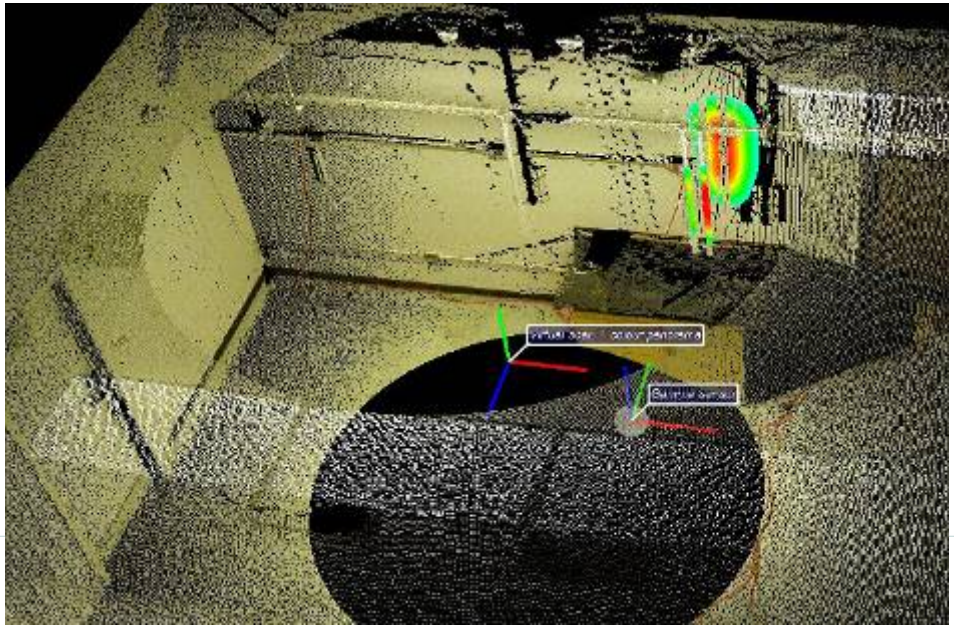
Gamma-ray imaging with 3-D laser scanning

Perceived need: Design information and nuclear materials distribution for complex nuclear facilities

Novel features: Integration of 3D-modelling technologies (JRC) with gamma imaging (LLNL, ORNL, …)





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Safeguarding of reprocessing plants

Nuclear analytical measurements at **On-Site Laboratories** on behalf of Euratom Safeguards, independently of the operators:

Sellafield Ltd — Sellafield, UK

AREVA NC — La Hague, France

The target uncertainties for the measurement of U/Pu in the input/output of the reprocessing plants are about 0.1% to 0.6%

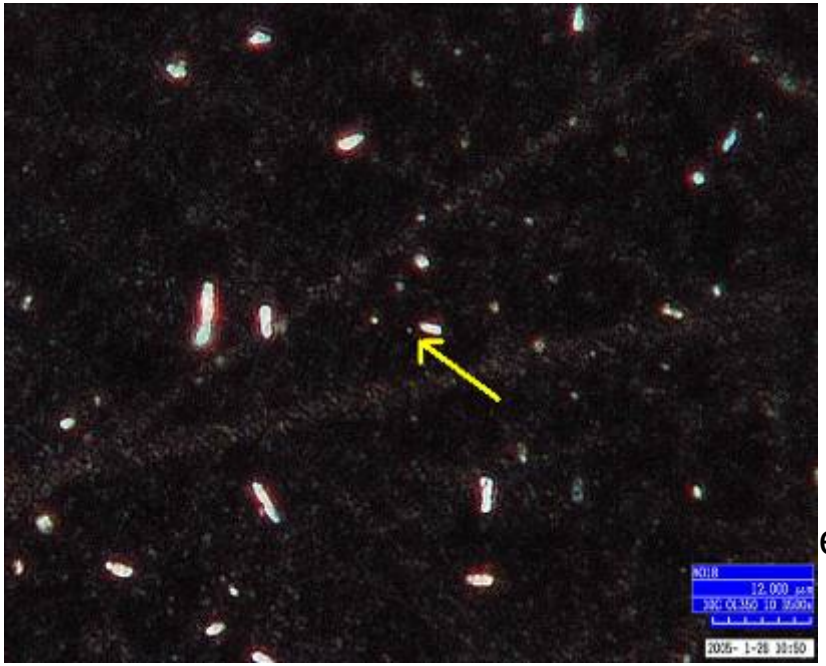
Absence of undeclared nuclear activities

Particle analysis from environmental sampling

The main goals:

- To search through millions of particles to find the particles of interest: "*needle in the haystack*"
- To make precise and accurate measurements of fissile isotopes.

analyses for Euratom and IAEA



Particle distribution. (Resolution 1050x and 3500x).

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Combating illicit trafficking of nuclear/radioactive material

Threat by nuclear /radiological terrorism

BORDER MONITORING ACTIVITIES

- Projects in:
  Ukraine, Armenia, Georgia, Belarus
- Provision of detection equipment at crucial nodal points

- *Border Monitoring Working Group* Coordination with US-SLD and IAEA
- Joint project implementation in Georgia (US-SLD/JRC)
- Joint Training in Ukraine (IAEA/US-SLD/JRC)

Nuclear forensics

February 22, 2007, Germany

14 Uranium Pellets found in a garden

Questions:

1. **How did the material get there?**
2. **Origin of the material ?**
3. **Intended use of the material?**
4. **Age of the material?**

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Nuclear forensics

Material attribution:

Chamfer width –

exp'tl.: 0.44 mm

Plant 1: 0.40 mm (RBU Hanau)

Plant 2: 0.61 mm

Production date was determined:
Nov./Dec. 1990, one year before physical protection was strengthened

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2010+: Towards an EU Security Training Centre at JRC

- Requested by EU member states and EU Commission services (DG-JLS), the centre will focus on training in nuclear security.
- Countries beyond EU participating to the Instrument for Nuclear Safety Cooperation and to the Instrument of Stability will also benefit from it.

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Conclusions

- Nuclear energy is an essential component of the European energy mix
- Continued safe and efficient operation of the present reactor generation (II, III) to be ensured
- For the sake of sustainability a transition to GEN IV reactors is mandatory
- Ensure nuclear controls and security within EU and beyond