

***OECD/NEA 11th Information
Exchange Meeting on Actinide
and Fission Product Partitioning
and Transmutation***



OECD/NEA activities related to Partitioning and Transmutation

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OECD Nuclear Energy Agency (NEA)

- ❑ **Founded in 1958 (currently 28 member countries, + ..)**
 - *A semi-autonomous agency of the OECD*
- ❑ **Forum for promoting international co-operation**
 - *Homogeneous membership (developed countries)*
- ❑ **Focus on scientific, technical, strategic and legal work**
 - *7 standing technical committees , ~70 working parties & expert groups*
 - *Flexibility*
- ❑ **Also Technical Secretariat of GIF and MDEP**



OECD/NEA activities related to P&T

- ❑ Fuel cycle transition scenarios
- ❑ Trends in the nuclear fuel cycle
- ❑ Benefits and impact of advanced fuel cycles with P&T
- ❑ Fuels and materials
- ❑ Fuel cycle chemistry
- ❑ Integral experiments for minor actinide management
- ❑ Peer review (MYRRHA)
- ❑ Conferences and workshops

These activities are conducted by the NSC (Nuclear Science Committee) and the NDC (Nuclear Development Committee)

Fuel cycle transition scenarios

□ Objective

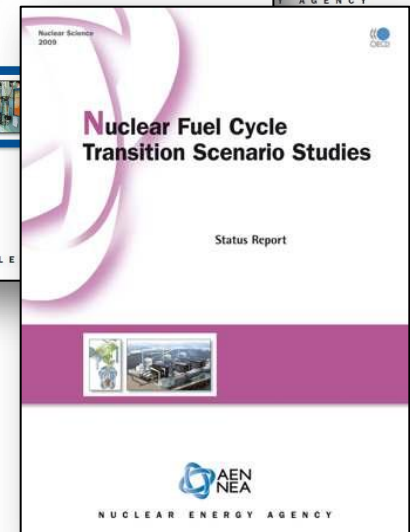
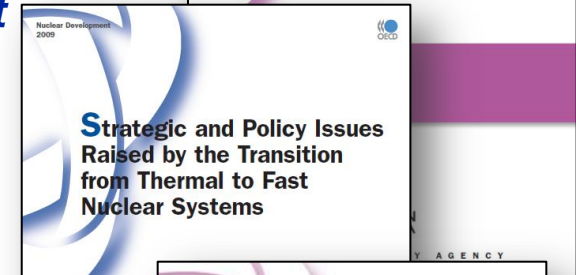
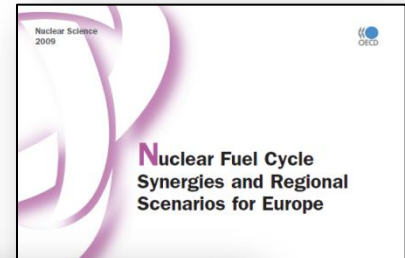
- *Study of transition scenarios from current to FR*
- *Discuss related scientific and strategic/policy issues*
- *Identify R&D needs for fast system deployment*

□ Published

- *Status report on fuel cycle transition scenarios (2009)*
- *Regional study on potential European fuel cycle transition (2009)*
- *Strategic and policy issues raised by the transition from thermal to fast nuclear systems (2009)*

□ On-going

- *Benchmark of scenario codes (finalised)* →
- *Global scenario study (final stage)* →



Benchmark of transition scenario codes

- ❑ **Objective**
 - *Compare existing scenario codes in term of capabilities, modelling methods and results*
- ❑ **Two phases**
 - *Phase 1 – Depletion calculation;*
 - *Phase 2 – Transition calculation*
- ❑ **Three scenarios**
 - *1. Once through;*
 - *2. Limited Pu recycling in LWRs;*
 - *3. Pu and MA recycling in FR*
- ❑ **Codes from Belgium, Canada, France, Germany, Italy, Japan, Spain and USA participate**
- ❑ **More info: Session 1 - Lionel Boucher (CEA)**

Global transition scenarios

❑ Objectives

- *Study a world transition scenario towards fast reactors*
- *Investigation of both homogeneous and heterogeneous scenarios*

❑ Topics

- *Uranium resource demand*
- *Reactor build rates*
- *Back end*
 - ❖ *Used fuel discharged as a function of time*
 - ❖ *Composition and radiotoxicity*
- *Infrastructure requirements as a function of time*
- *Selected sensitivity studies (includes LWR only case for comparison)*

❑ More info: **Session 1 – A. Schwenk-Ferrero (KIT)**

Trends in the nuclear fuel cycle

□ Objective

- *Update of “Trends in the Nuclear Fuel Cycle (NFC): Economic, Environmental and Social Aspects (2002)”*

□ Scope

- *Investigate developments in the NFC and analyse trends*

- ❖ Over the past decade / in the future
- ❖ In the technical development of NFC / with respect to sustainability goals / nationally and internationally

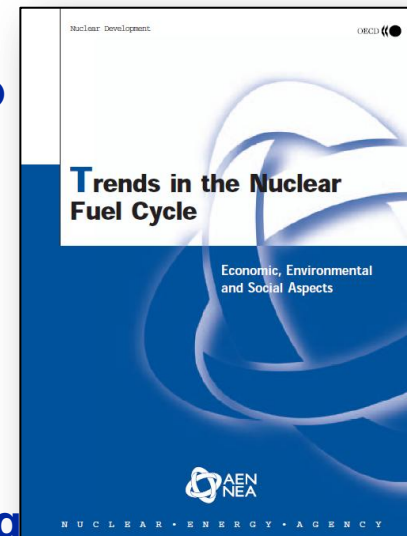
- *Analyse the sustainability elements of NFCs*

- ❖ Economic (cost, optimise use of resources)
- ❖ Social (enhance safety, proliferation resistance)
- ❖ Environment (reduce impacts)

- *Focus on policy and strategies*

- ❖ Review experience and perspectives in policy making
- ❖ Provide a strong technical basis

□ To be published by the end of 2011



Potential benefits and impact of advanced fuel cycles with P&T

□ Objectives

- *Analyse various studies on the impact of P&T on geological disposals, to identify common conclusions and the need for future work based on various advanced fuel cycles*
- *Assess the impact on geological repository characteristics and make recommendations on appropriate criteria to evaluate the impact of P&T based on the level of losses during fuel re-processing*

□ Recent studies show

- *Evolution of the role of P&T*
 - ❖ P&T is not longer considered as a stand alone option
- *Option can be integrated in advanced fuel cycles*
 - ❖ Increase sustainability, efficient use of U resources, waste minimisation, higher economics, safety and proliferation resistance (e.g. Gen-IV)

□ Final review in progress

Potential benefits and impact of advanced fuel cycles with P&T (main findings)

- ❑ Impact on geological disposal
 - *Possible reduction of heat load, radiotoxicity and dose*
- ❑ P&T and geological disposal
 - *For existing reprocessed waste: no impact*
 - *For existing spent fuel: impact depends on*
 - ❖ National strategies on nuclear industry (phase-out/reprocessing)
 - ❖ Transition scenarios / delay in deployment of FR
 - *For advanced fuel cycles with P&T*
 - ❖ Possible implementation in some countries in 30 years (France, Japan, Russia, China, ...)
 - ❖ Anyway, geological disposal will be still needed for long-lived fission and activation products + actinide losses
- ❑ **More info: Session II - R. Wigeland (INL)**

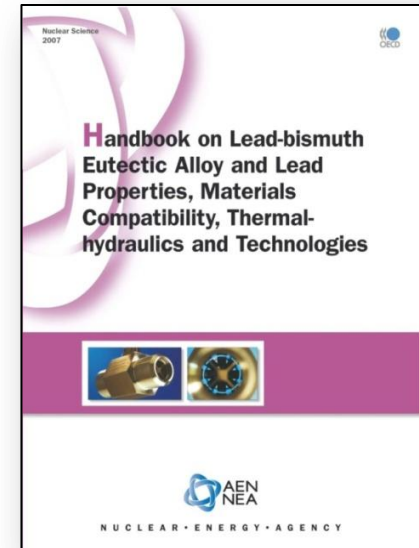
Fuels and materials

□ Objectives

- *Update information on fuels and materials for implementing advanced nuclear fuel cycles*
- *Evaluation of innovative fuels and materials technologies, including fabrication processes and performances*
- *Study heavy liquid metal (HLM) technology*

□ Output

- *Status report on innovative fuels (on-going)* →
- *Status report on innovative structure materials (final stage)* →
- *LBE Handbook (update on-going)*
- *Thermal hydraulic characteristics of LBE (on-going)*



Innovative fuels

□ Objectives

- *Study technical issues associated with the development of innovative fuels, mostly minor actinide contained fuels and clad materials, targeted for use in advanced fuel cycles*
- *Establish a innovative fuels database*

□ Status report

- *Metal, oxide, nitride, dispersion fuels (CERCER, CERMET), special mechanic fuel forms (Sphere-pac, Vibro-pac, Particle fuels)*
- *Field of interest*
 - ❖ *Fabrication, characterisation and irradiation performance, Safety characteristics, Design and safety criteria, System dependency - Cladding materials, Technical readiness level*

□ First draft by the end of 2010

□ More info: Session 3

Innovative structure materials

□ Objectives

- *Study innovative structural materials under extreme conditions such as high temperature, high dose rate and corrosive chemical environment and long service lifetime*
- *Establish a innovative structure material database*

□ Status report

- *Current R&D status on structure materials for Gen-IV and ADS*
- *Contribution from Belgium, France, Germany, Italy, Japan, Korea, Switzerland, Spain, UK, USA*

□ Final review in progress

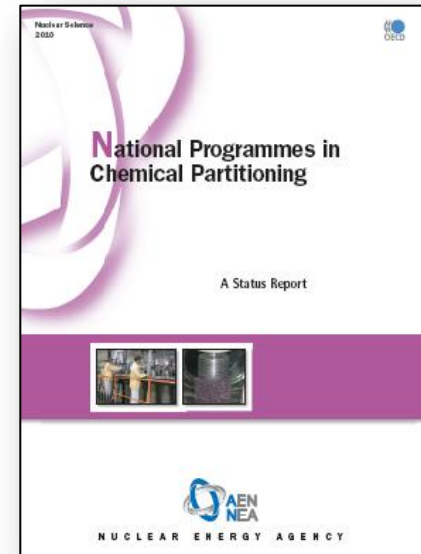
Chemical partitioning

□ Objectives

- *Technical assessments of various separations processes*
- *Develop a scientific basis of nuclear waste recycle*
- *Study nuclear data for radioactive waste management*

□ Output

- *National programmes in chemical partitioning (published in 2010)*
- *Flowsheet studies (finalised)*
- *Curium management (finalised)*
- *Progress in separation chemistry and future R&D (on-going)* →



Separation chemistry

- ❑ **Update status of reprocessing technologies**
- ❑ **Scope of the study**
 - *Progress of separation technology and current achievement*
 - ❖ Hydrometallurgy,
 - ❖ Pyrometallurgy: metal and oxide electro-refining
 - ❖ Other process - Fluoride volatility, FLUREX
 - ❖ Head-end processes
 - *Separation requirements from the viewpoint of fuel cycle scenario*
 - *Perspective of future R&D*
- ❑ **First draft by the end 2010**
- ❑ **More info: see papers in Session IV**

Integral experiments for minor actinide (MA) management

- **Objectives**
 - *Review of nuclear data and target accuracy required for MA management and of existing integral data*
 - *Request and priority list of nuclear reactions/events, energy range and measurement error*
- **Scope of the study**
 - *Identify current issued and required experiments specification for optimal MA management*
 - *Evaluate availability of existing experimental facilities and need of new facility development*
 - *Establish secure route of supplying MA samples*
 - *Improvement of experimental technique*
 - *Foster international cooperation*
- **9 partners (Be, Ch, De, Fr, It, Jp, Ko, RF, US)**
- **First draft report by end 2011**

International Peer Review of the MYRRHA Project

- ❑ International peer-reviews are part of the NEA activities (at the request of member countries govts)
- ❑ MYRRHA: an accelerator driven lead-bismuth eutectic cooled sub-critical reactor
- ❑ Review team of 7 high-level experts from 7 different countries
- ❑ Report published at the end of 2009
- ❑ Main recommendation endorsed by the Belgian government
 - Further phase (*“Risk reduction and allocation before proceeding to construction”*)
- ❑ Belgian gvt will fund 40% if marks of interest of potential investors transformed in hard commitments

Conferences and workshops

- ❑ **Technology and components of ADS (TCADS)**
- ❑ **Structural materials for innovative nuclear systems (SMINS)**
- ❑ **Actinides and fission product partitioning and transmutation (IEMPT)**

Workshop on technology and components of ADS (TCADS-1)

- **15-17 Mar 2010, Karlsruhe, Germany hosted by KIT**
 - *~70 presentations, ~100 participants from 18 member countries, IAEA, CERN, EC*
- **Scope**
 - *R&D status of ADS, including accelerators*
 - *Neutron sources and sub-critical systems for current facilities, as well as future experimental and power systems*
 - *Technology, engineering and research aspects of the above components*
 - *System optimisation for reducing capital and operational costs*
 - *Role of ADS in advanced fuel cycles*

Main findings of TCADS-1

- ❑ **Projects around the world are progressing**
 - *EUROTRANS (EC), MYRRHA (Belgium), J-PARC (Japan), SNS (USA), MEGAPIE (Switzerland)*
- ❑ **Improved technologies**
 - *Beam stability, Windowless target, spallation sources, materials*
- ❑ **Increase of sub-critical system designs**
 - *Fuel cycle issues, fuels and materials, system analysis*
- ❑ **Innovative ADS**
 - *ADS with Th fuels, Am/Cm burner*
- ❑ **Proceedings are under preparation**

2nd workshop on structural materials for innovative nuclear systems (SMINS-2)

- Hosted by KAERI, Daejon, Korea, 31 Aug- 3 Sep 2010
 - *~80 presentations, ~100 participants from 15 countries and IAEA*
- **Scope**
 - *Fundamental studies, modelling and experiments on innovative structure materials including cladding materials for the range of advanced nuclear systems such as thermal/fast systems, sub-critical systems, as well as fusion systems*
- **Topics**
 - *Fundamental studies; Metallic materials; Ceramic materials; Novel materials pathways*
- **Plenary talks and round table discussions organised**

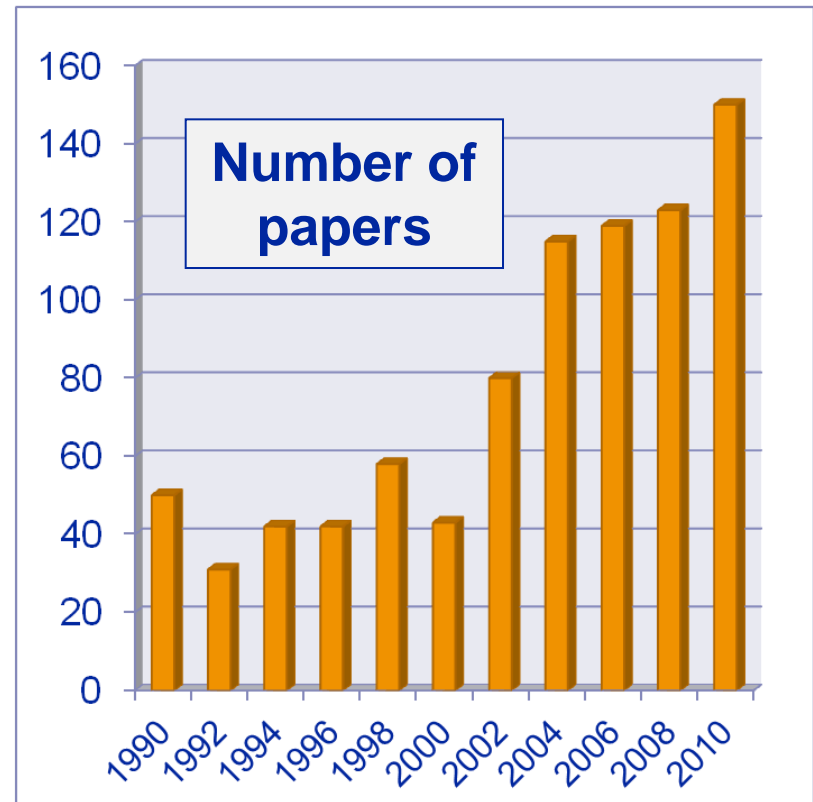
Main findings of SMINS-2

- **Summary session: “Critical experiments, modelling needs and round robin opportunities”**
 - *Issues for innovative structure materials were identified*
 - *Technical readiness level (TRL) could be a proper tool to evaluate current R&D level*
 - *International data base on structural materials for innovative nuclear system is needed*
 - *Further collaboration with material scientists in non-nuclear field is needed*
 - *SMINS workshop should be continued covering both the modelling and measurement community*
- **Proceedings are under preparation**

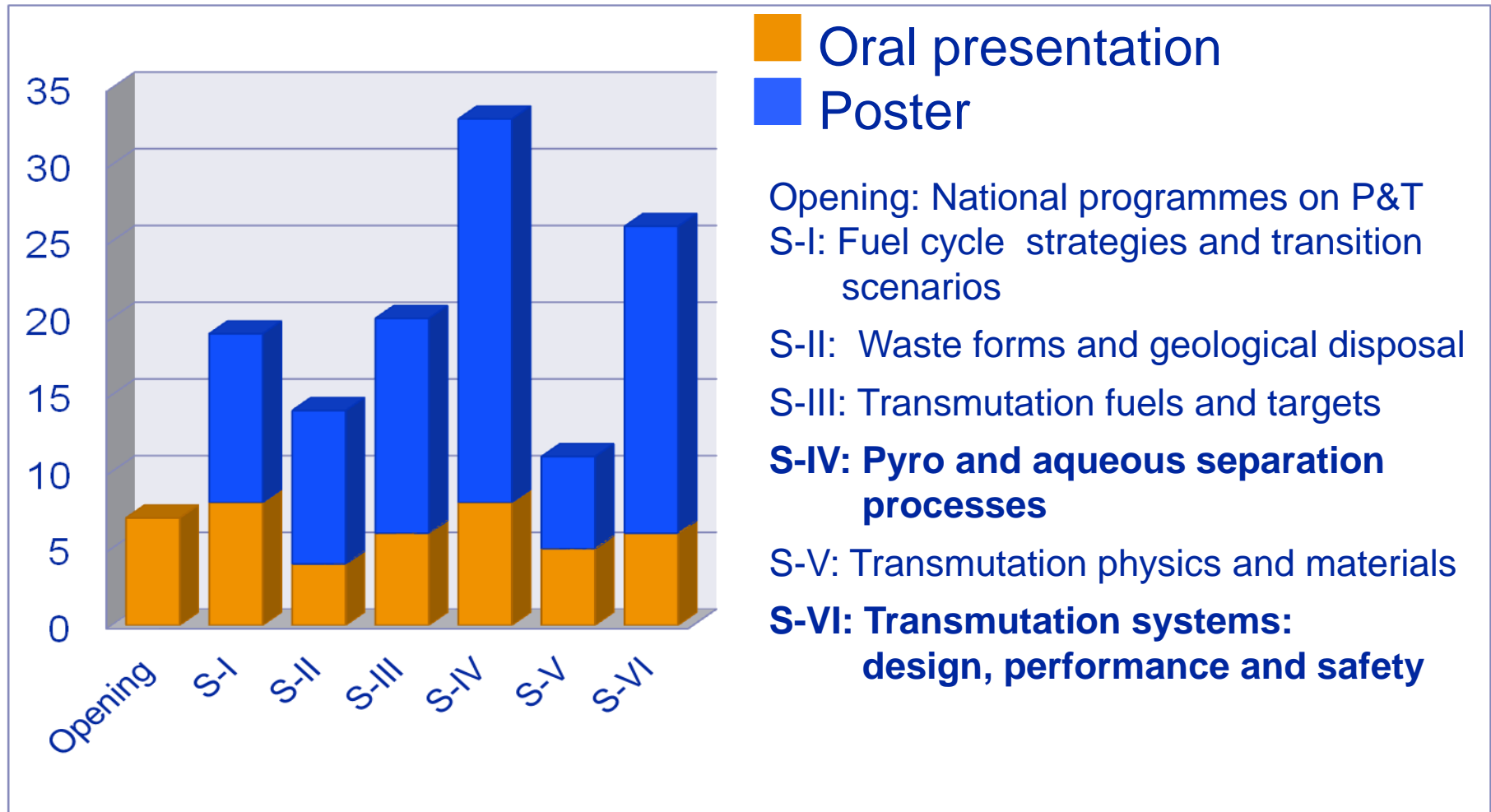
Information Exchange Meetings on Actinide and Fission Product P&T (IEMPT)

- Forum for discussing scientific and strategic developments in the field of P&T (since 1990)

Mito (Japan) 1990
 ANL (USA) 1992
 Cadarache (France) 1994
 Mito (Japan) 1996
 Mol (Belgium) 1998
 Madrid (Spain) 2000
 Jeju (Korea) 2002
 Las Vegas (USA) 2004
 Nimes (France) 2006
 Mito (Japan) 2008
San Francisco (USA) 2010
 Prague (Czech Rep.) 2012



Papers by session at the 11th IEMPT



Concluding Remarks

- ❑ **Numerous and various NEA activities related to P&T**
 - *Covering both scientific and strategic aspects*
- ❑ **Main activities in the areas of**
 - *Transition scenarios, fuels and materials, and fuel cycle chemistry*
- ❑ **Increased interest noted in**
 - *Thorium cycle, nuclear fuel “deep burn”*
 - *Economics*
- ❑ ***A lively P&T community***
- ❑ ***Large number of options considered***
- ❑ ***Need to consider industry views***