

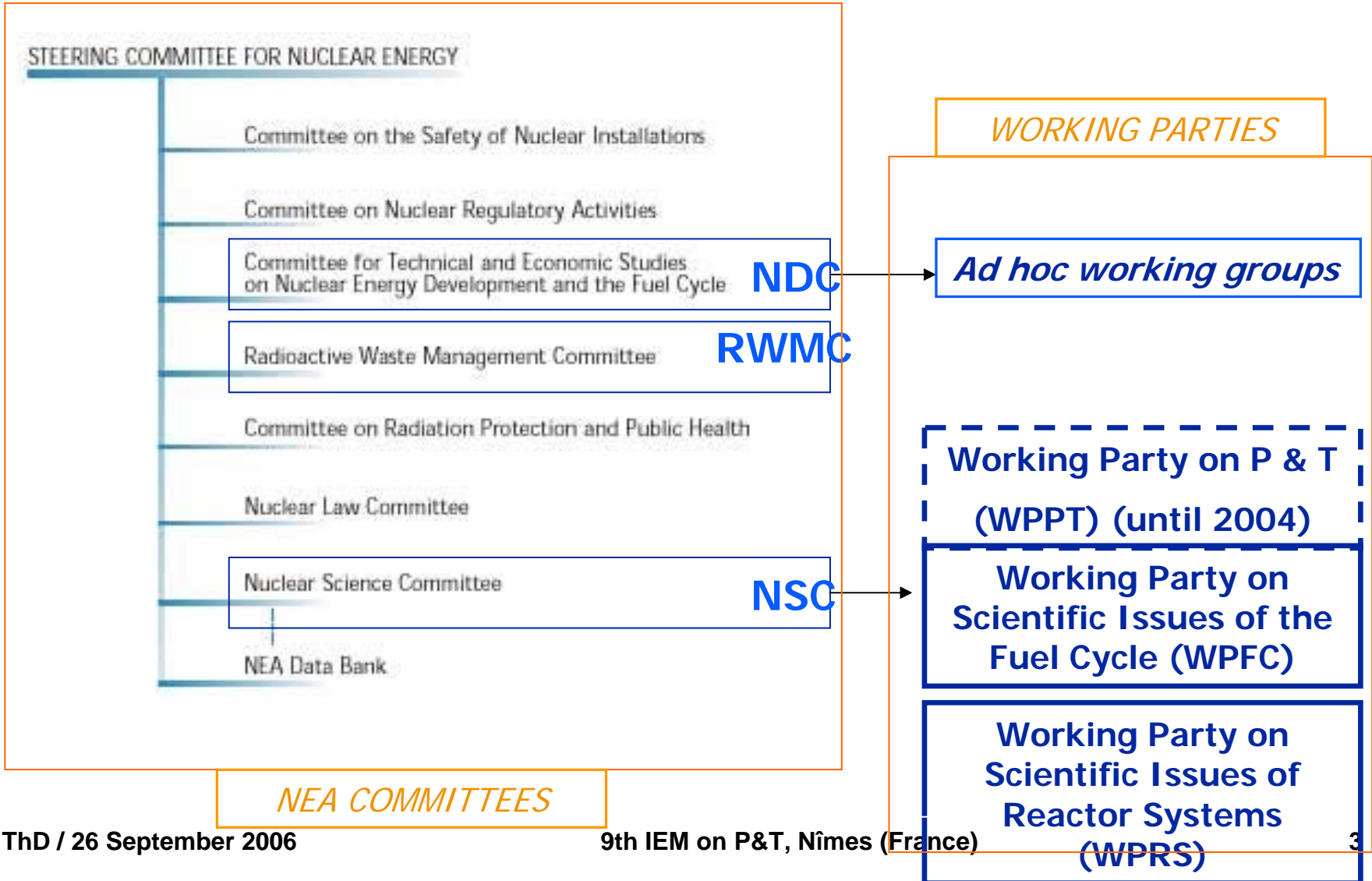
# Overview of NEA Activities in Actinide and Fission Product Partitioning and Transmutation

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# Recent and On-going NEA Activities on P & T

- ◆ **Scientific issues**
  - **Physics**
  - **Chemistry**
- ◆ **Strategic issues**
- ◆ **Other activities**

# NEA Committees Involvement in P & T



# Scientific Issues

## ◆ Physics

- Accelerator and Spallation Target Technologies for ADS Applications
- Benchmark study on Beam Interruptions in ADS
- Physics and safety of transmutation systems
- Series of Workshops on Utilisation and Reliability of high power proton accelerators

## ◆ Chemistry

- Fuels and Materials for Transmutation
- Lead-Bismuth Eutectic Handbook

# Accelerator and Spallation Target Technologies for ADS Applications

*WPPT - subgroup on accelerator utilisation and reliability*

- ◆ Status report published in 2005
- ◆ Contributions from 16 Institutes and National Labs
- ◆ Review of
  - the two major accelerator options for ADS
  - spallation target technology
  - technologies scalable to industry
    - ❖ a linear accelerator driving a Pb-Bi eutectic spallation source seems to be a system providing the necessary neutron fluence

# Benchmark on Beam Interruptions in Accelerator-driven Systems

## *WPPT / WPFC Subgroup on Accelerator Utilisation*

- ◆ Three phase study of temperature and power variations induced by accelerator beam interruptions
  - Phase I: minimal models
  - Phase II: with 'fresh' fuels
  - Phase III: under irradiated fuel conditions
- ◆ Reports for Phases I and II have been published (2003 and 2004). Phase III is on-going

# Physics and Safety of Transmutation Systems

## *WPPT*

- ◆ **Status report published in 2006**
- ◆ **Contributors for 10 Institutes and National Labs**
- ◆ **Contents**
  - **P & T and the role of ADS**
  - **Scenario studies for P&T: time dependent P&T studies, overview of software, applications to ADS**
  - **ADS dynamics and safety**
  - **Transmutation of long-lived fission products**
  - **Impact of nuclear data uncertainties on ADS design parameters**

# Fuels and Materials for Transmutation

## *WPPT*

- ◆ **Status report published in 2005**
- ◆ **Contributors from 16 Institutes and National Labs**
- ◆ **Contents**
  - **Thermo-physical and thermo-chemical data for relevant actinide compounds and alloys**
  - **Fuel selection criteria and fuel fabrication**
  - **Prediction of fuel behaviour**
  - **Structural materials: cladding and compatibility with molten heavy metals**
  - **Transmutation of long-lived fission products**
  - **Hydrides as moderators**



# Handbook on Lead Bismuth Eutectic (1)

## *WPFC, subgroup on LBE technology*

- ◆ **Critical review of existing literature and data on Pb and LBE**
  - leading to standards
  - identifying areas where further studies are needed
  - establishing a common methodology for experiments and data analysis
- ◆ **Contributors from 8 Institutes and National Labs from 7 member countries**

# Handbook on Lead Bismuth Eutectic (2)

## ◆ Areas covered

- Thermophysical, electrical, transport and chemical thermodynamics data
- Chemistry (in particular, oxygen level control and monitoring)
- Material science aspects: behaviour under irradiation conditions
- Compatibility with structural materials with/out proton irradiation
- Thermohydraulics, Instrumentation and Safety aspects

## ◆ Version 0 planned for 2006 - update for 2009

# Series of Workshops on the Utilisation and Reliability of High Power Proton Accelerators

## *WPFC subgroup on accelerator utilisation*

- ◆ **5th Workshop will take place in Mol (Belgium) hosted by SCK/CEN, 6/9 May 2007, and will include the following topics:**

- **Accelerator programmes and applications**
- **Accelerator reliability**
- **Spallation target development and coolant technology**
- **Sub-critical system design and ADS simulations**
- **Safety and control of ADS**
- **ADS experiments and test facilities**

# Strategic Issues

- ◆ **Status report on national programmes in partitioning**
- ◆ **Studies of fuel cycle transition scenarios**
- ◆ **Impact of advanced fuel cycles on waste management policies**

# Status Report on National Programmes in Partitioning

## *WPFC, subgroup on chemical partitioning*

- ◆ **Subgroup objectives:**
  - perform a thorough technical assessment of separations processes in application to a broad set of P&T operating scenarios
  - identify important research, development and demonstration necessary to bring preferred technologies to a deployable stage, and
  - recommend collaborative international efforts to further technology development
- ◆ **Reports received from 9 member countries for both aqueous and pyrochemical partitioning processes**
- ◆ **To be published in 2007**

# Fuel Cycle Transition Scenarios (1)

## *WPFC, subgroup on fuel cycle transition scenarios*

- ◆ **Preparation of a general report on transition scenarios (to be published in 2006)**
  - **Timing of key technologies**
  - **Overview of country-dependent scenarios**
  - **Systematic discussion of key issues**
  
- ◆ **System code benchmark study (ongoing, to be published in 2007)**
  - **3 scenarios: once through / limited Pu recycling in LWRs / Pu and MA recycling in FRs**

# Fuel Cycle Transition Scenarios (2)

## ◆ Regional approaches

- To be published in 2007
- Regionally sharing facilities and inventories to optimize resources and to match enhanced non-proliferation requirements
- 2 groups of countries
  - ❖ Phase-out policies
  - ❖ Continuation (Pu in ADS or FRs)
- 4 scenarios

*invited talk by Massimo Salvatores*

# Impact of Advanced Fuel Cycles in Waste Management Policies

*NDC ad hoc working group*

- ◆ Report published in May 2006
- ◆ Building on
  - Integration Group for the Safety Case (RWMC)
  - NSC working group on flow-sheet studies
- ◆ Analysis of advanced fuel cycle options from the perspective of their effects in waste management options, in particular repositories for HLW
  - Impact on HLW isotopic composition on repository performance
  - Impact on repository size and cost

*Invited talk by Jean-Marc Cavedon (TS IV – Thursday)*



# Other Activities

- ◆ **This series of Information Exchange Meetings on Actinide and Fission Product Partitioning and Transmutation**
  - **10th - Tokai-Mura, Japan - November 2008**
- ◆ **International Peer Reviews**
- ◆ **New activities**
  - **Structural Materials for Innovative Nuclear Systems (SMINS)**
  - **Expert Group on “ab-initio” Modelling and Simulation (AI-MS)**

# International Peer Review of the French P&T Programme (1)

- ◆ At the request of the French Government, in the context of the French Law (Bataille) of Dec 1991
- ◆ Focusing on the CEA Report 2005 on P & T
- ◆ Carried out by 10 international experts
- ◆ Objectives of the peer review
  - Assess the soundness of the Report in terms of scientific and technical approach; methodology; results and strategy
  - Formulate detailed recommendations for improvement which may help the decision-making process leading to an application phase of P&T

# International Peer Review of the French P & T Programme (2)

*15 conclusions – 20 recommendations*

- ◆ **Very high quality of the R&D carried out**
- ◆ **The IRT accepts that long term management of actinides via fast reactors is a practical possibility**
- ◆ **Scope and limits of the report**
  - **The report does not try to address an integrated approach of the impact of P&T on the whole fuel cycle**
  - **P&T is almost always considered in terms of reduction of radiotoxicity. Other criteria, such as reduced heat loading, reduced waste volume or impact on the fuel cycle cost should also be considered**
    - ❖ **Heat load --- > Strontium**

# International Peer Review of the French P & T Programme (3)

- ◆ **Recycling technology for transmutation fuels and targets should be developed in close relationship with the fuel and target development programme itself**
- ◆ **Separation Am / Cm**
- ◆ **The report should address more fully the difficulty of handling of multigram quantities of minor actinides in the fuel cycle**
- ◆ **Fuel and target development after 2009 might be difficult with the closure of Phénix**

*Available as an NEA 2006 Publication*

# Workshop on the Structural Materials for Innovative Nuclear Systems (SMINS)

- ◆ Following a proposal from Germany to NSC
  - ◆ Workshop - FZK / Karlsruhe - 4/6 June 2007
  - ◆ Focus on structural materials for systems such as Generation IV reactors, critical and sub-critical transmutation systems and fusion devices
  - ◆ Explore commonalities and differences in terms
    - of laboratory & large facility scale experimental tech.
    - modeling and simulation
- in order to identify and develop potential synergies

***[www.nea.fr/html/science/struct\\_mater](http://www.nea.fr/html/science/struct_mater)***

# Start-up of an Expert Group on “ab-initio” Modelling and Simulation (AI-MS)

- ◆ Following a proposal from USA to NSC
- ◆ Activity oriented towards fuels and the development of modelling and simulation capabilities that may be used for computer experiments for fuel development
- ◆ Currently preparing a detailed proposal for the mandate and programme of work of the Expert Group

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# Concluding Remarks

- ◆ Numerous and various NEA activities
- ◆ Horizontal/crosscutting within the NEA
- ◆ Balance between science and strategy
  - Altogether a good measure of the major concern regarding the management of HLW*
- ◆ For the future
  - Balance between activities (ADS ?)
  - Need of feedback to help defining the most valuable NEA activities for its member countries