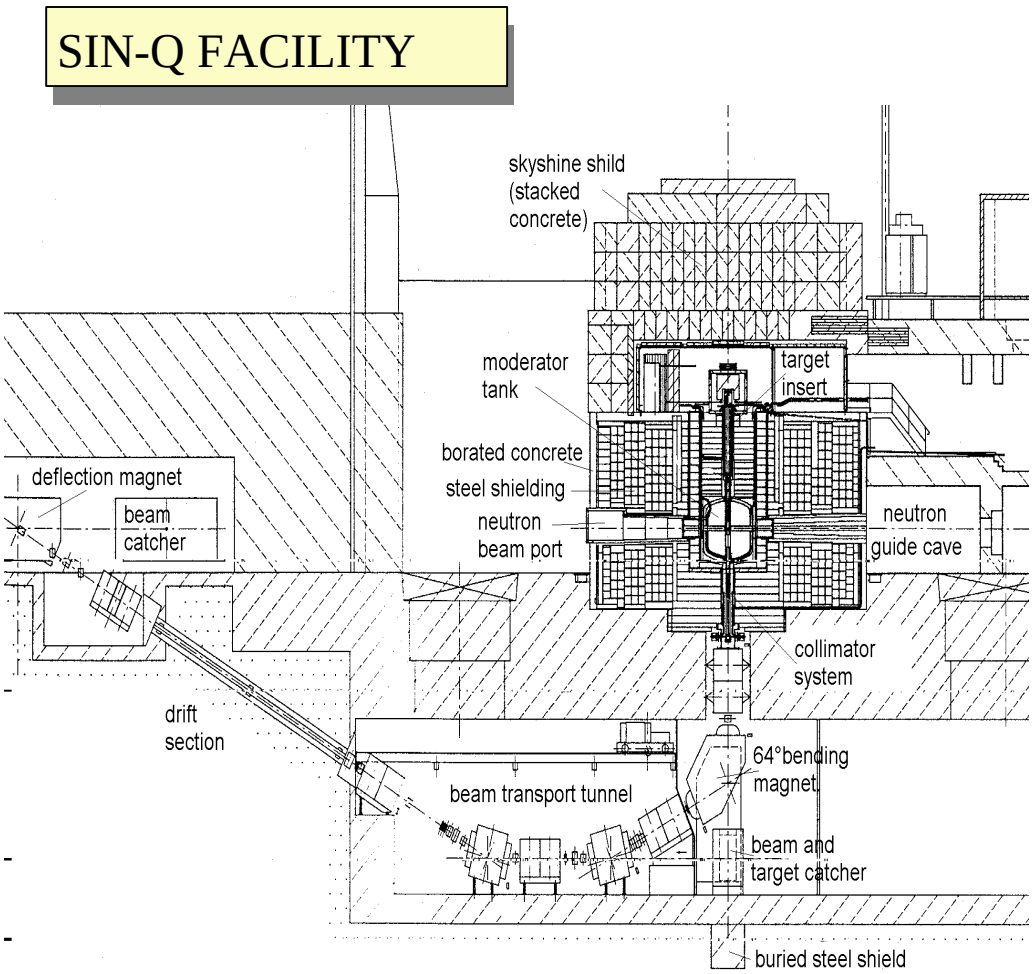
ADS Research & Development, 3/8

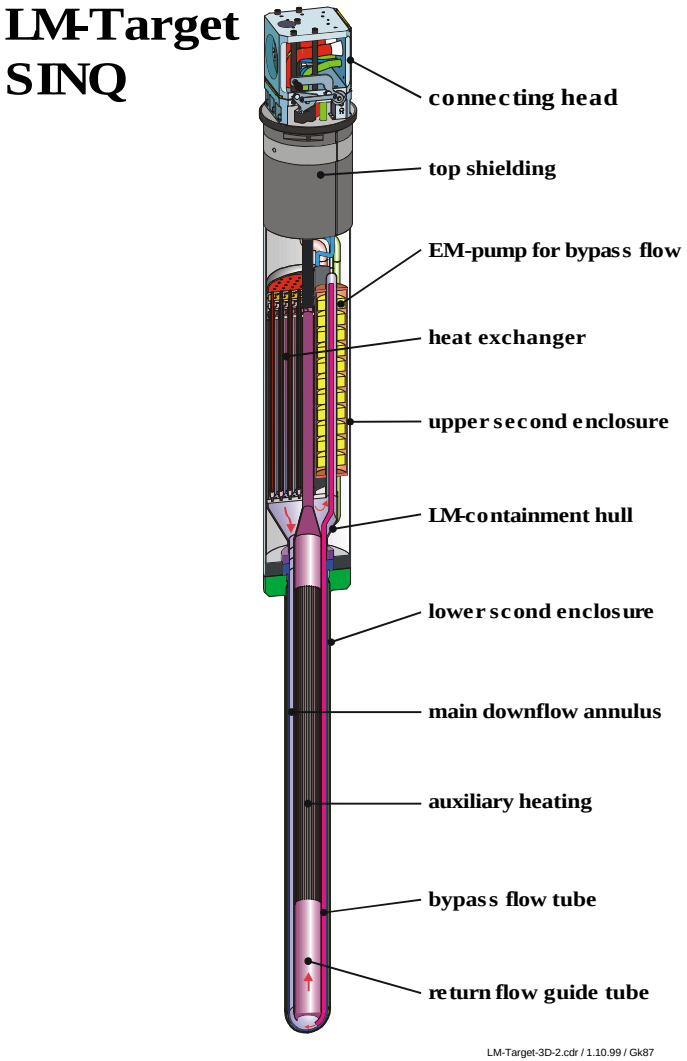
- Main R&D needs for next years
  - Development of high intensity accelerators and high power spallation sources,
  - Their integration with sub-critical fissile blankets
  - Development of advanced fuel fabrication and reprocessing technology

ADS Research & Development, 4/8

- Main facilities and experiments
  - High intensity accelerators: IPHI (High Intensity Proton Injector) in France, and TRASCO (TRAsmutazione SCOrie) in Italy, on the design of a high current and
  - High power spallation sources: MEGAPIE (MEGAwatt PIlot Experiment), at the SINQ facility (spallation neutron source driven by a cyclotron) in Switzerland

ADS Research & Development, 5/8





Source: Y. Kadi, CERN (pers. comm.)

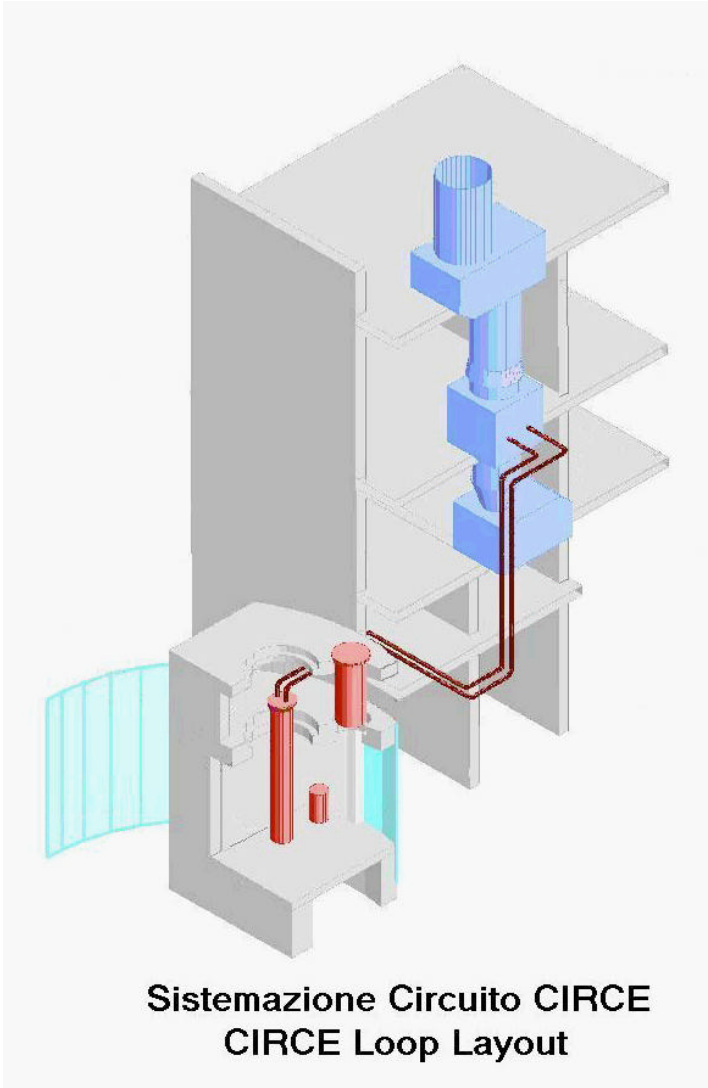
ADS Research & Development, 6/8

- MUSE-4 Fast sub-critical zero power assembly driven by (d,d) or (d,t) neutron source with deuterons provided by the GENEPI pulsed accelerator (MASURCA, Cadarache, France)
- YALINA Thermal sub-critical zero power assembly driven by (d,d) and (d,t) 14 MeV neutron source (Minsk, Belarus)
- MYRRHA Multi-purpose sub-critical accelerator-driven R&D reactor (20-30 MW) planned by SCK?CEN, Mol, Belgium
- SAD Sub-critical accelerator-driven MOX fuelled R&D facility (15-20 kW) planned by JINR Dubna, Russia

ADS Research & Development, 7/8

- N_TOF (Neutron Time Of Flight) nuclear XS measurements at CERN, Geneva
- JRC-IRMM neutron data studies at JRC, Geel
- JRC-ITU the minor actinide (fuel fabrication and advanced aqueous and pyro-processing studies) at JRC-IT, Karlsruhe
- KALLA (KArlsruhe Lead LAboratory), and
- CIRCE (CIRCuito Eutettico, ENEA, Brasimone, Italy) facilities for Pb and Pb-Bi eutectic technology development

ADS Research & Development, 8/8



Source: Y. Kadi, CERN (pers. comm.)

P&T Open Questions, 1/6

- Issues to be evaluated
  - Cost
  - Technical feasibility
  - Effect on repository performance
  - Sociological impact

P&T Open Questions, 2/6

- Cost
  - Reprocessing capacity
  - Partitioning facilities
  - Fuel and target fabrication facilities
  - Advanced transmutation reactor systems

P&T Open Questions, 3/6

- Technical feasibility
  - Partitioning requirements, separation technology
  - Fuel and target fabrication
  - Transmutation reactor systems

P&T Open Questions, 4/6

- Effect on repository performance
  - Decay heat
  - Reduction of “radio-toxic life time”
  - Radio-toxicity egress into biosphere
    - Groundwater flow scenario ? radio-nuclides solubility limits
    - Human intrusion scenario
  - Proliferation risks

P&T Open Questions, 5/6

- Sociological impact
  - What price for shortening the “radio-toxic life time” of the final geologic repository?
  - Beneficial for nuclear waste debate?

P&T Open Questions, 6/6

- Bottom line
  - P&T potential to incinerate (fission) actinides and shorten the “radio-toxic” life time of the geologic repository by 3 orders of magnitude
  - P&T requires development of advanced fuel cycles
  - Comprehensive comparative assessment of P&T potential against and as part of existing and alternative strategies needed

IAEA's Role and Activities, 1/13

- Framework given by project "Technology Advances in Fast Reactors and Accelerator Driven Systems for Actinide and Long-lived Fission Product Transmutation"
- Mechanisms: technical information exchange meetings, co-operative R&D projects (Coordinated Research Projects, CRPs), status reports, data bases

IAEA's Role and Activities, 2/13

- Major implementation and delivery mechanism for the activities is the Technical Working Group on Fast Reactors (TWG-FR, formerly IWG-FR)
  - Conveys Member States' needs
  - Supports activity planning
  - Ensures support for implementing the activities in MS
  - Present membership: Belarus, Brazil, China, France, Germany, India, Italy, Japan, Republic of Korea, Russia, Switzerland, UK, USA, EC, OECD/NEA

IAEA's Role and Activities, 3/13

- Technical information exchange meetings
  - "Coolant Technology for Sub-critical Blankets of Fusion/Fission Hybrids", Moscow, 6-7 July 2000:
    - reviewed the status of the fusion/fission hybrids R&D activities, especially coolant technologies
    - identified areas of common interest between the fusion and fission communities and the corresponding R&D
    - contributed towards defining the Agency's supporting role

IAEA's Role and Activities, 4/13

- "Core Physics and Engineering Aspects of Emerging Nuclear Energy Systems for Energy Generation and Transmutation", Argonne National Laboratory, 25 Nov.–4 Dec. 2000
  - reviewed the status of R&D activities in the area of hybrid systems for energy generation and transmutation
  - discussed specific issues covering the different R&D topics for these systems
  - recommended to IAEA activities specifically targeted to the needs of the Member States

IAEA's Role and Activities, 5/13

- Planned technical information exchange activities (2002 – 2003)
  - "Theoretical and Experimental Studies of Heavy Liquid Metal Thermal Hydraulics"
  - "Assessment of ADS Dynamics and Safety Physics"
  - "Review of Solid and Mobile Fuels for P&T"
  - "Background Report on the Use of Fusion/Fission Hybrids for Utilization and Transmutation of Actinides and Long-lived Fission Products"

IAEA's Role and Activities, 6/13

- Coordinated Research Projects (CRP)
  - CRP on "Potential of Thorium-based Fuel Cycles to Constrain Plutonium and to Reduce Long-term Waste Toxicities"
    - Specific objective: to investigate fuel cycle options in which plutonium can be incinerated with thorium
    - The CRP addresses the radio-toxicity accumulation and transmutation potential of thorium based fuel cycles in both current and advanced/innovative reactors

IAEA's Role and Activities, 7/13

- CRP on "Safety, Environmental, and Non-proliferation Aspects of Partitioning &Transmutation of Long-lived Actinides and Fission Products"
  - Specific objectives:
    - to focus on advanced partitioning processes for selected radio-nuclides (Sr, Cs, Tc, I, Am, Np, and Cm)
    - to evaluate the incentives, from the safety, environmental and non-proliferation aspects on partitioning-only and P&T systems
  - The CRP identifies the important radio-nuclides for P&T and addresses the advanced aqueous and pyrochemical processes for partitioning with emphasis on reduction of secondary waste generation

IAEA's Role and Activities, 8/13

- Planned Coordinated Research Projects (CRP)
  - CRP on "Studies of Advanced Reactor Technology Options for Effective Incineration of Radioactive Waste"
    - Extra-budgetary activity
    - Kick-off Research Coordination Meeting (RCM) planned for February 2002 (FZ Karlsruhe)
    - Info sheet and call for participation sent to MS

IAEA's Role and Activities, 9/13

- Objective: to perform R&D tasks contributing towards the proof of practicality for long-lived waste transmutation. In particular, to contribute towards providing the basis for the assessment of both the short and long term benefits (or lack of those) to the nuclear fuel backend of ADS transmutation as compared to other existing, advanced, and innovative concepts
- The first stage of the CRP will center on analyses of safety relevant parameters (main thrust on long time-scale effects of transients)
- Benchmark models based on various designs of the sub-critical core, also extreme cases ("dedicated" to transmutation)
- The CRP will also seek to perform experimental benchmarks

IAEA's Role and Activities, 10/13

- CRP on "Benchmark Analyses on Data and Calculational Methods for Accelerator Driven System (ADS) Source Related Neutronic Phenomenology with Experimental Validation"
  - Extra-budgetary activity
  - Kick-off Research Coordination Meeting (RCM) planned for 2002
  - Info Sheet and call for participation in preparation

IAEA's Role and Activities, 11/13

- Objective: to improve the present understanding of the coupling of ADS spallation sources with multiplicative sub-critical nuclear systems
- The proposed CRP will address all major physics phenomena of the spallation source and its coupling to the sub-critical system
- Integrated calculation schemes will be used by the participants to perform computational and experimental benchmark analyses

IAEA's Role and Activities, 12/13

- Data base on R&D related to ADS
  - provide MS with up-to-date, consistent and readily accessible reference information on existing and developing experimental facilities and codes for R&D in the ADS area
  - assist the IAEA in implementing its ADS related programmes
  - assist the IAEA in identifying future activities
- Status of the data base
  - Internet-based version available, being tested internally at IAEA
  - Urgent: start data collection, contributions will be solicited shortly

IAEA's Role and Activities, 13/13

- Status report IAEA-TECDOC-985 :

  "Accelerator Driven Systems: Energy Generation and Transmutation of Nuclear Waste"

Conclusions, 1/5

- P&T research and development activities must
  - Look beyond P&T's potential to incinerate (fission) actinides and shorten the "radio-toxic" life time of the geologic repository
  - Be based on a comprehensive assessment of
    - Cost
    - Technical feasibility
    - Effect on repository performance
    - Sociological impact

Conclusions, 2/5

- Be implemented within a global approach
  - Based on comparative assessments vis-à-vis other existing, evolutionary and advanced fuel cycle strategies; and
  - Address reactor and fuel technology development, and the associated fuel cycle strategies

Conclusions, 3/5

- Responding to MS needs, IAEA has developed a strong interest in transmutation related R&D
- Ensuing activities cover evolutionary technologies (e.g., advanced fast reactors) and innovative concepts (e.g., ADS, thorium cycle, molten-salt concepts, fusion/fission hybrids)

Conclusions, 4/5

- Co-operation with other International Organizations (OECD/NEA, EC, ISTC) is a must and is vigorously pursued
- Strong synergies can be gained, e.g., from co-operation with ISTC projects:
  - Experimental studies are essential for data and methods validation
  - IAEA's activities (CRPs and technical meetings) offer the opportunity to widen the international participation in benchmarking and validation, and foster international team-building and information exchange

Conclusions, 5/5

Information, **“virtual” collaboration**, **data bases**,and **full-text downloads**
with regard to IAEA’s project
“Technology Advances in Fast Reactors and Accelerator Driven Systems for Actinide and LLFP Transmutation”
to be found on the project’s Web Site:

http://www.iaea.org/inis/aws/fnss/