Availability of Research and Test Facilities for Fast Reactor Development

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As a result of economic situations and declining budgets in nuclear development in many OECD/NEA Member countries it is observed that numerous problems occur:

- for maintaining the present technical levels in the field of nuclear technology;
- In preserving existing integral data accumulated in the course of the nuclear development so far.
In order to overcome these difficulties the NEA has initiated various activities:

- Workshop on R&D needs for current and future Nuclear Systems in November 2002;
- NSC is reviewing existing integral reactor physics data within the IRPhE (International Reactor Physics Experiments) evaluation project;
- NDC has identified mechanisms and policies for promoting international collaboration in the area of nuclear education and R&D;
- CSNI has established an expert group to study “Support Facilities for Existing and Advanced Reactors (SFEAR)”
Introduction (3)

- It was concluded by the NSC that further discussions on R&D needs were essential to profit from the synergy of these studies;

- Therefore the NSC tasked an Expert Group in 2005 to seek and anticipate future needs of research facilities for R&D needs in Nuclear Science:
  - Based on the results of former studies;
  - In close collaboration with other NEA standing technical committees;
  - With the aim that the study should contribute to promoting international collaboration for the development of new nuclear technologies.
Mandate of the Expert Group

- Reviewing the status of research and test facilities worldwide and clarifying future needs of research facilities corresponding to the R&D needs in nuclear science and technology;
- Monitoring the NSC activities on preservation of existing integral reactor data, reactor characteristics and fuel cycle in order to identify the future needs in research facilities;
- Establishing recommendations on future needs of research facilities in nuclear science for international collaboration
Deliverables of the Expert Group

- Organise Expert Group meetings to review and exchange information on the status of integral data and needs for research and test facilities for future R&D in the field of nuclear science and technology. This work to be undertaken in close collaboration with CSNI and NDC;

- Establish a database of research and test facilities for R&D in the field of nuclear science and technology, and to clarify the status and the needs of these facilities;

- Produce a report on the status of integral data and the need of research and test facilities for the future R&D in nuclear science and technology.
An initial “template” was defined containing 33 items of information to be collected for each facility;

Entries were added from information derived from a number of sources:

- from the members of the expert group themselves;
- from the NuCoC database;
- from the SFEAR report;
- From the IAEA Research Reactor Database;
- from the IAEA databases on Fast Reactors and ADS systems;
- from the NuPECC Handbook;
- from the NEA report on Lead Bismuth Eutectics;
- from the members of the NEA Nuclear Science Committee.
During 2006 a subsidiary project has developed a web-based version of the database;

Because the database is intended for access by users around the world, it was felt important that each entry was checked and agreed by the facility owners;

The Research and Test Facilities Database (RTFDB) has grown over 700 checked records;

The database was released to OECD-member countries on 20 July 2007;

http://www.nea.fr/rtfdb/
Structure of the report is based on the structure of the database:

- Based on “applications” rather than on “facility types”
- “Applications” consider topics such as Nuclear Data Measurements; Reactor Development; ADS; fuel, materials, etc..
- “Facility types” such as accelerators, reactors, hot-cells, etc. are found in the subsequent sections as the applications for which they are used.
OECD/NEA report on “future Research and Test Facilities needed in Nuclear Science and Technology” has been published in 2009;

Is available through OECD/NEA;

Research and Test Facilities Required in Nuclear Science and Technology
The Expert Group classified the discussion of facilities on **Applications** using the same grouping as in the database;
The main areas of consideration were:
- Nuclear Data Measurements
- **Reactor Development**
- Neutron Applications
- ADS and Transmutation Systems
- **Fuel Research**
- Material Research
- Safety Research
- The areas in bold are those of most relevance to this conference
It is evident that experimental validation of neutronics continues to be required;

Interpretation of reactor physics experiments requires two components:
- The data describing the basic underlying phenomena of the macroscopic system behaviour and
- Computer codes to predict the macroscopic or integral effects.

Essential to maintain, in addition to the integral facilities, facilities providing newly-required or improved basic data.

Furthermore, it is essential to maintain and extend the Integral Reactor Physics Experiments (IRPhE) database in order to preserve former and new experimental data.
The Expert Group remarked that:

- many of the existing research reactors were put into operation in the 1960’s and thus clearly ageing;
- at the time of the report just 4 fast neutron research reactors were being operated worldwide;
- In the mean time Phénix is shutdown but CEFR in China will diverge in 2010.

Clear need for fast spectrum test facilities in the future:

- France is considering the construction of ASTRID
- Belgium is considering the construction of MYRRHA
The Expert Group

- Recommended that further federation of the financial, scientific and technical efforts of the OECD-countries could optimise available resources;
- Recorded its belief that OECD-countries could possibly give a new impetus to the promotion of the relevant R&D in order to encourage innovation in the nuclear industry;
- Concluded that the GNEP partnership is an indication of the desire for increased collaboration within the international nuclear power community;
- Noted the key role played by international institutions, such as OECD/NEA, EC and IAEA, in promotion of co-operation between countries.
The Expert Group noted the need for:

- development of new facilities for GEN-IV conditions (high temperature, high fluxes, neutron spectrum, cooling type...);
- maintaining the long term availability of hot-cells plus the associated facilities to undertake the necessary Post Irradiation Examination;
- Maintaining and extending the International Fuel Performance Experiments (IFPE) database in order to preserve former and new experimental data.

In relation to Fuel Cycle Chemistry the Expert Group further noted that:

- a considerable effort is needed to scale-up the proposed partitioning processes to pilot scale and subsequently to industrial scale;
- the strict regulations limiting the quantities of MA which can be handled in shielded facilities and the construction costs of facilities to fulfil the MA handling requirements is becoming a determining factor among P&T oriented countries.
Study of structural materials for fast reactor systems are largely studied in the same type of installations as used for fuel.

Similar conclusions/recommendations can be drawn.

In addition the report also considers Liquid Metal Test Facilities:
- in the past largely studied as reactor core coolants, for fusion energy blanket applications;
- now also for ADS, spallation sources;
- also for some GEN-IV reactor systems.

In relation to LFR’s as well as ADS systems, the importance was recognised of:
- advanced materials for LBE applications and;
- thermo-hydraulic studies on LBE systems
Conclusions

- Expert Group on “Needs of Research and Test Facilities in Nuclear Science” was set-up in 2005 under guidance of the NSC of the OECD/NEA.

- The Expert Group has produced:
  - A report: “Research and Test Facilities in Nuclear Science and Technology” which was published in the fall of 2009 and is available as an OECD/NEA publication (ISBN 978-92-64-99070-8)
  - The associated “Research and Test Facilities Data Base” was released to OECD-member countries on 20 July 2007 and contains 700 checked records and is openly consultable at: http://www.nea.fr/rtfdb/

- Part of this work is of importance “Fast Reactors and related Fuel Cycles”.