

Nuclear Facilities in OECD Countries: Status and Outlook

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Introduction (1)

As a result of recent economic situations and declining budgets in nuclear development in many OECD/NEA Member countries:

- Numerous problems 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.

Introduction (2)

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 ; third edition is available;
- 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.

The database (1)

- 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.

The database (2)

- 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/>

The Report (1)

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; etc.....
- “Facility types” such as accelerators,reactors,hot-cells,etc..are found in the sub-sequent sections as the applications for which they are used.

Report (2)

- OECD/NEA report on “future Research and Test Facilities needed in Nuclear Science and Technology” is in preparation;
- Expected for the end of this year;
- Premature to draw already recommendations;
- Instead in following slides an attempt will be given to show what can be expected and which research areas are covered.

Two types are considered :

- Facilities for **measurement of microscopic nuclear data**. Examples are cross section measurements, decay data, fission yields, fission neutron multiplicities and spectra, isotopic half-lives, etc...
- Facilities for **measurement of integral data** (i.e. benchmark experiments) needed for validating the evaluated data files

Reactor Development

- NPP's continue to seek improved performance through up-rating of power output, the use of higher burn-up fuel, longer operating cycles,.....;
- Reactor configurations are becoming more heterogeneous both in composition and in distribution of power throughout the core;
- Evident that experimental validation of neutronics continues to be required;
- Potential increasing need as new designs such as GEN-IV systems are being considered;
- Needs for research reactors, critical and sub-critical assemblies are analysed

Neutron Applications

- Two applications of neutrons are frequently undertaken on reactors namely:
 - Neutron Scattering
 - Neutron Radiography
- For Neutron Radiography ,three application domains have been explicated:
 - Non-destructive analysis of Nuclear Fuel;
 - The inspection capabilities for highly radioactive spent fuel;
 - Neutron tomography.

ADS and Transmutation Systems

- Transmutation of long-lived nuclides contained in spent fuel is one of the key technologies for sustainable utilisation of nuclear energy;
- Critical and sub-critical reactors (ADS) are considered;
- Three R&D-areas are explicated:
 - Basic database for minor actinides and long-lived fission products;
 - Fuel and fuel cycle technology;
 - Specific activities for ADS : accelerator, spallation target, sub-critical core and accelerator coupling experiments.
- For the near future a clear need is identified for a Fast Neutron Irradiation Facility.

- The study of nuclear fuel in order to ensure its appropriate behaviour in-core in steady-state, incidental and accidental conditions is a long-standing issue;
- Development of new facilities for GEN-IV conditions (high temperature, high fluxes, neutron spectrum, cooling type...) are seen as important;
- This sub-charter considers:
 - Facilities for performing test on fuel (irradiation facilities and test reactors);
 - Facilities for the subsequent examination of the fuel and its cladding (hot cells)

- Study of structural materials for existing and future reactor systems are largely studied in the same type of installations as used for fuel.
- Similar conclusions/recommendations can be drawn.
- In addition this chapter 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.

Safety Research

- Safety is an over-riding issue in all nuclear related research;
- NEA CSNI has published the SFEAR (Support Facilities for the Existing and Advanced Reactors) report which focused on the safety issue;
- SFEAR was limited safety issues, research needs and supporting research facilities for currently operating reactors and in a lesser extend to HTGR's;
- SFEAR report covers also Thermal Hydraulics and Severe Accidents , which are not covered by EGNRTF;
- Recommendations for SFEAR are explicitly recorded by the EGNRTF.

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.
- Expected output :
 - A report : “Research and Test Facilities in Nuclear Science and Technology”: expected for the fall 2008, final draft is in circulation for review
 - An associated database which was named “RTFDB” for “Research and Test Facilities Data Base”: released to OECD-member countries on 20 July 2007 and contains 700 checked records.
 - See <http://www.nea.fr/rtfdb/>