IAEA Activities on Fast Reactor Programme

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Outline

- Fast Reactor Technology Development: IAEA Vision
- TWG-FR: Technical Working Group on Fast Reactors
- Programmatic Approach:
  - Modeling & Simulations
  - Technical Support
  - FR Safety
  - Information Exchange
  - Education & Training
  - Knowledge Preservation
- International Conferences on Fast Reactors
- Main Achievements and Outputs
Nuclear Power Technology Development: Fast Reactors

FR Development: IAEA Vision

- Create an effective platform for exchange of information and share lessons learned
- Carry out focused R&D activities on crucial issues
- Agree and converge on safety approaches, design criteria and guidelines at the international level
- Share experience on experimental facilities
- Develop, verify and validate advanced simulation tools through benchmarking
- Provide cutting-edge opportunities for education and training
- Collect, retrieve, preserve and make available existing documents, data and information on fast reactors (i.e. guarantee knowledge preservation on fast reactors).
Programme Drivers and Constraints

IAEA Statute & GC Resolutions (e.g. “Strengthening” DG Report)

MP1 Medium Term Strategy

Advice from SAGNE

Advice from TWG, TMs

Biennual Programme & Budget

Programme Content
TM, CMs, CRPs, ICSPs, Training, Publications, Tool-kits, Portals
The IAEA Technical Working Group on Fast Reactors (TWG-FR)

Members of the IAEA Technical Working Group on Fast Reactors

<table>
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<tr>
<th>Full Members</th>
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48th Annual Meeting of the TWG-FR
IPPE, Obninsk, Russia
25-29 May 2015

49th Annual Meeting of the TWG-FR
CNEA, Buenos Aires, Argentina
16-20 May 2016
Programmatic Areas: Fast Reactors

- Technology Support
- Modelling and Simulations
- Knowledge Preservation
- Safety
- Education & Training
Recent FR Achievements

• CRPs:
  • Completed: MONJU, PHENIX EOL, ADS
  • Ongoing: NAPRO, EBR-II
  • Just Started: PFBR-ST
  • In Plans: MONJU-TTT, FFTF, CEFR

• Education and Training:

• Publications:
Major Planned Outputs

- FR 17 Conference
- FRKP portal
- SFR Simulator
- EBR-II Benchmark Results
- Handbook on Sodium Properties
The “International Conference on Fast Reactors and Related Fuel Cycle” represents the most important event on fast reactors and related fuel cycles technology.

- FR09 in Kyoto, Japan, 2009
- FR17 in Yekaterinburg, Russian Federation, 26-29 June, 2017
EBR-II CRP: Benchmark Analyses of the Shutdown Heat Removal Tests Performed in the EBR-II Reactor

- A very productive verification and validation exercise accomplished.
- 20 Organizations from 12 countries
- Final RCM of the CRP: 25-29 April 2016
- Compilation of final simulation results and produce consolidated document in one year
NAPRO CRP: Sodium properties and safe operation of experimental facilities in support of the development and deployment of SFR

- **WP1**: Collection and assessment of sodium properties: international harmonization of data and correlations to be published in the form of a handbook
- **WP2**: Design rules and best practice for Na exp. facilities
- **WP3**: Guidelines for the safe operation of Na exp. facilities
- **4th RCM in Vienna, 1st Q 2017**
- **First draft of Na Handbook (WP1): to be published in 2016(2017)**

Argentina (CNEA) China (CIAE) France (CEA) India (IGCAR) Germany (KIT, HZDR) Japan (JAEA) Korea, Republic of (KAERI) Netherlands (NRG) Russian Federation (IPPE) USA (ANL)
CRP on Radioactive Release from the Indian Prototype Fast Breeder Reactor (PFBR) under Severe Accident Conditions

Evaluation of:

- Transport of fission products (FP), Na and other radioactive materials from the melted core to the cover gas
- Ejection of FP, Na, fuel particles through the penetrations of the top shield reactor structure directly into the containment system and indirectly through the argon cover gas system
- Transport of fission products and other radioactive materials through the different containment compartments under various thermodynamics conditions

Reference design for the safety analysis:

500 MWe pool type PFBR

First RCM: Vienna, 3-6 May 2016
IAEA FR KOS
KNOW WHAT
and
KNOW WHERE

Links to other Knowledge Resources

END USERS
experts and general users of fast reactor data and documentation

Users’ group:
Data providers
Taxonomy users
Readers

General Principles:
Document repositories on SharePoint. Access to fast reactor related documentation that MS wish to share

• Confidentiality and Intellectual property rights
• Sharing and access
  Uploads by MS themselves possible
  Documents provided by MS will be in control of MS (e.g. definition of rights for other parties)

IAEA
JAPAN
USA
INDIA
GERMANY
FRANCE
RUSSIA
UK
CHINA

DATA, INFORMATION AND KNOW-HOW HOLDERS

Information and/or metadata

DATA, INFORMATION AND KNOW-HOW HOLDERS

ITALY
KOREA, REPUBLIC OF
BELARUS
SWITZERLAND
BELGIUM
UKRAINE
KAZAKHSTAN
ROMANIA
ARGENTINA
Fast Reactor Knowledge Organization System (FR-KOS)

It is generally recognized that long-term development of nuclear power as a part of the world's future energy mix will require fast reactor technology with a closed fuel cycle. The fast neutron spectrum allows fast reactors to increase the energy yield from natural uranium by a factor of sixty to seventy compared to thermal reactors, granting therefore realization of nuclear power programmes for thousands of years, as well as a significant improvement of nuclear waste management. It is for these reasons that fast reactors have been under development for decades in several countries, primarily as breeders and, in recent years, also as High-Level Waste burners.

The necessary condition for successful deployment in the near and mid-term is the understanding and assessment of technological and design options, based on both past knowledge and experience, as well as on scientific and technological research efforts.

With regard to the first, the design and operation of several sodium-cooled fast reactors, such as the Fast Flux Test Facility (FFTF) in USA, the small size Prototype Fast Reactor in the United Kingdom, the prototype Phenix in France, the BN-350 in Kazakhstan, the demonstration plant BN-600 in Russia, Monju in Japan, the commercial size Superphenix in France, etc.
E&T: Development of SFR Simulator for Educational Purposes

- Funded by IAEA RB + MEXT-Japan + in-kind contributions from other interested MSs
- 1st CM to finalize specs: January 2016

Final Detailed Technical Specifications prepared by IAEA: ready by April 2016
E&T: Joint IAEA-ICTP Workshop on Physics and Technology of Innovative Nuclear Energy Systems for Sustainable Development

- **29th August – 2nd September 2016**
- **Trieste, Italy**

**Joint ICTP-IAEA Workshop on Physics and Technology of Innovative Nuclear Energy Systems for Sustainable Development | (smr 2850)**

**PURPOSE:** The purpose of the workshop is twofold.

1. To provide training and exchange of information on the importance of innovation and continued research and technology development in achieving the full potential of nuclear energy as a long-term, sustainable part of the world's energy mix, and.
2. To enhance the status of worldwide innovative nuclear systems and associated advanced fuel cycles.

**MOTIVATION:** The aim is to impart theoretical foundation of all aspects of innovative nuclear energy systems and to
GIF-IAEA Workshop(s) on Safety of SFR – 2011-Present

http://www.iaea.org/INPRO/cooperation/Second_IAEA-GIF_WS_on_SFRs

2nd GIF-IAEA Workshop on Safety of SFR: 2011
4th GIF-IAEA Workshop on Safety of SFR: June 2014
5th GIF-IAEA Workshop on Safety of SFR: June 2015

6th GIF-IAEA Workshop on Safety of SFR: 14-15 November 2016
Conclusions

- Fast reactors technology has been brought to a high level of technical maturity in the last decades by the design, construction and operation of experimental and prototype reactors, and a number of construction projects are currently ongoing.

- Several countries are engaged in the development of innovative (GEN-IV) FR concepts: SFR, LFR, GFR, MSFR.

- Important research efforts are worldwide devoted to cover technology gaps and improve safety features, especially in the light of the Fukushima event.

- In order to promote cooperation, international initiatives have been established in last years: GIF, INPRO, ESNII.

- The IAEA supports Member States activities by providing a forum for information exchange and implementing R&D programmes.
Thanks for Your Attention!

...Atoms for Peace & Development