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**Forty-Fifth Meeting of the
Technical Working Group on Fast Reactors (TWG-FR)**

**Argonne National Laboratory (ANL)
Argonne, IL, USA**

20–22 June 2012

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**Forty-Fifth Meeting of the
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MEETING REPORT

1. INTRODUCTION

The 45th Annual Meeting of the Technical Working Group on Fast Reactors (TWG-FR) was held from 20 – 22 June 2011 in Argonne, USA, hosted by the Argonne National Laboratory (ANL).

The meeting was attended by the TWG-FR Members and Advisers from the following Member States (MS): Argentina (Observer), Belgium, Belarus, France, Germany, India, Italy, Japan, the Netherlands, the Republic of Korea, the Russian Federation, Ukraine, Sweden, and the United States of America, as well as by the representative of the OECD/NEA. Apologies for not being able to participate were received from China, Kazakhstan and Switzerland.

The objectives of the meeting were to:

- Exchange information on the national programmes on Fast Reactors (FR) and Accelerator Driven Systems (ADS);
- Review the progress since the 44th TWG-FR Annual Meeting, including the status of the actions;
- Consider topical technical meeting arrangements for 2012-2013, as well as review FR-related activities included in the IAEA Programme & Budget (P&B) biennium 2012-2013;
- Review the IAEA's concluded, on-going and planned coordinated research projects in the technical fields relevant to the TWG-FR (FRs and ADS), as well as coordination of the

TWG-FR's activities with other organizations and international initiatives (GIF, INPRO, NEA, ESNII, etc.)

Agenda of the meeting is in Annex I, list of participants is in Annex II.

2. OPENING SESSION

The participants were welcomed Mr S. Monti, TWG-FR Scientific Secretary, who underlined that the meeting, being the 45th in a series, represents a new milestone for the TWG-FR.

The participants were also welcomed by Mr R. Hill, Director of Advanced Reactor Concept Programme under DOE, who briefly reminded the US programme on fast reactor and in particular the strong ANL commitment on this technology.

After the welcome addresses, Mr J.K. Park, Director of Nuclear Power Division at the IAEA, gave the following opening remarks:

“Good morning ladies and gentlemen,

On behalf of the International Atomic Energy Agency, I would like to express my deep gratitude to the Argonne National Lab. for hosting this very important event on Fast Reactors.

Being the 45th meeting, this meeting represents a new milestone for the TWG-FR, the first-born international TWG of the IAEA;

The attendance of the representatives from 14 MSs and 1 international organization demonstrates the increasing interest of the Member States in Fast Reactors and Accelerator Driven Systems. This is also confirmed by the large participation in the recent FR-related initiatives launched by the IAEA.

The biennium 2011-2012 has seen very busy for the IAEA in the field of FR including, further to the regular annual TWG-FR meeting:

- *8 Technical Meetings on various scientific and technical aspects such as advanced Heat Exchangers and Steam Generators, innovative FR with enhanced reactivity effects, lessons learned from Fukushima on safety of FR, identification of gaps for the further FR development, Knowledge preservation, etc.;*
- *3 Workshops concerning the very hot topic of safety; in particular I would like to mention the “IAEA-IAEA International Workshop on prevention and mitigation of severe accidents in SFR” held last week in Tsuruga and concluded with a press conference in Tokyo where representatives of the IAEA and the member states with an active program on SFR delivered high level messages concerning safety approach, safety regulation and R&D needs for innovative FR;*
- *3 Education & Training Seminars on the different FR technologies, as well as the environmental degradation of materials and components under high flux fast neutron spectrum;*
- *2 Research Coordination Meetings on Coordinated Research Projects (Monju and Phenix) and, the last but not the least, the launch of a new CRP on Benchmark Analysis of an EBR-II Shutdown heat removal test, the 1st RCM has been held early this week here at ANL. From this respect we have to thank US for making available to the international scientific*

community the experimental data coming from the tests conducted in the 80s in the EBR-II reactor, within the framework of the US Integral Fast reactor development and demonstration program. We are also very happy to acknowledge the very large participation in this CRP from 16 organizations of 10 MSs.

Whilst it is my pleasure to inform you about the publication of the Proceedings of the IAEA Conference on Fast Reactors and Related Fuel Cycles held in Kyoto in 2009, I also take this opportunity to announce that the 2nd International Conference on Fast Reactors is scheduled in March 2013 in Paris, which is hosted by the French Government. This conference will focus on the two main peculiarities of fast reactors, safe technologies and sustainable scenarios.

The IAEA secretariat, in collaboration with CEA and SFEN, is concentrating all its efforts to make this conference a success as it was the case for FR09. Of paramount importance is of course the role of the International Advisory Committee and of the International Scientific Program Committee which have started their intense work of drafting the conference program, identifying technical sessions, track leaders and invited speakers, starting the very demanding process review of abstracts and papers.

Let me also point out that there is a number of relevant FR-related IAEA publications in-progress; in particular it is expected very soon the publication of the Status Report on FR Research and Technology Development, a 850-page document which you have contributed in drafting during the last few years and which summarizes the state-of-the-art and the future developments of this nuclear technology;

After the Fukushima accident last year, enhancement of the nuclear safety taking into account the lessons learned has become the highest and the most urgent priority of the nuclear community. As you know, also the IAEA is concentrating its effort on this topic, in particular with the implementation of its Safety Action Plan prepared with the fundamental support and advise from the Member States and the nuclear stakeholders. From a technical point of view, there are advantages of FR which would answer some of the issues associated with Fukushima. However, as recognized in recent TMs organized under the umbrella of the TWG-FR, there is a lesson learned and an impact also on the safety of FRs. Analysis of the Fukushima accident and its consequences on FR development is still in progress and comparison and possible harmonization of the safety approach in different countries will be possible when this analysis reaches a more developed stage. At that very moment the IAEA will be asked to take action in developing and recommending a common safety approach, as well as safety standards and guide lines for innovative FRs, and in this very demanding task the contribution and advise of the TWG-FR will be very essential. Therefore, I would recommend to this TWG to continue the very fruitful discussion on the impact of the Fukushima accident on safety of FR and to plan for future initiatives which can support the Agency in this difficult task.

In closing my remarks, I wish you all a successful meeting and I declare this TWG meeting is open, and I turn this meeting into the hands of the Scientific Secretary, Mr Stefano Monti.

Thank you."

Afterwards, an overview of the Department of Energy's Office of Nuclear Energy (NE) advanced reactor research and development (R&D) programme was provided by the Director of the Office of Advanced Reactor Technologies, Mr. Thomas J. O'Connor. The overview highlighted NE's

mission to support currently deployed light water reactors, develop new technologies and sustainable fuel cycles while striving to reduce the risks of nuclear proliferation and terrorism. The overview included organizational structure and current and future budgets. The advanced reactor programs are broken up into three major areas: Advanced Reactor Concepts focused on sodium cooled fast reactors, the Next Generation Nuclear Plant Demonstration Project focused on high temperature gas cooled reactors, and the Advanced Small Modular Reactor R&D focused on those attributes necessary to deploy advanced reactors in small modular reactor configurations. Activities to support currently operating light water reactors and the near term licensing of small modular reactors capable of being operational by 2022 was also discussed. In summary, NE's R&D portfolio is broad, and focused on keeping the existing fleet operating safely, moving technology to commercialization through targeted R&D and cutting edge R&D to support advanced concepts. These R&D activities are conducted at the Argonne, Brookhaven, Sandia, Los Alamos and Idaho National Laboratories, and U.S. universities and through various international collaborations.

After the self-introduction, the meeting participants appointed Mr R. Hill as chairman of the 45th TWG-FR annual meeting and as chairman of the TWG-FR starting with the 45th till the 46th TWG-FR meeting in 2013.

The chairman presented the agenda of the meeting which was approved by the participants as reported in annex I.

3. PROGRESS REPORTS ON NATIONAL PROGRAMMES AND INTERNATIONAL ORGANIZATIONS

There were the following 17 presentations made by the representatives of 14 Member States and the OECD-NEA:

- *Argentinean activities related to Fast Reactors* - presented by Mr. O. Azpitarte (CNEA, Argentina);
- *Belarus activity in ADS field* – presented by Ms H. Kiyavitskaya (SOSNY, Belarus);
- *On-going activities in Belgium in the field of FR & ADS: the progress since 2010* – presented by Mr. D. De Bruyn (SCK.CEN, Belgium);
- *ASTRID: Advanced Sodium Technological Reactor for Industrial Demonstration* - presented by Mr. A. Vasile (CEA, France);
- *Technical Working Group on Fast Reactors: German Report* - presented by Mr. W. Maschek (KIT, Germany);
- *Fast reactor research in Dresden-Rossendorf* – presented by Mr. B. Merk (HZDR, Germany);
- *Status of fast reactor development in India: April 2011 – March 2012* - presented by Mr P. Puthiyavinayagam (IGCAR, India);
- *Progress report on the Italian national programme on fast reactors* - presented by Mr. P. Agostini (ENEA, Italy);
- *Progress on fast reactor development in Japan* - presented by Mr. H. Ohira as far as status of Monju and by Mr. N. Uto as far as JSFR (JAEA, Japan);
- *Status of fast reactor technology development in Korea* - presented by Mr. J. Chang (KAERI, Republic of Korea);

- *Status of regulatory research for Sodium-cooled Fast Reactor* – presented by Mr. A. Shin (KINS, Republic of Korea);
- *Dutch fast reactor related activities 2011-2012* – presented by Mr. F. Roelofs (NRG, The Netherlands);
- *State of the art of fast reactors in Russia in 2011 and prospects of their development* - presented by Mr Y. Ashurko (IPPE, Russian Federation);
- *Genius and the Swedish fast reactor programme* – presented by J. Wallenius (KTH, Sweden);
- *National Science Centre “Kharkov Institute of Physics and Technology”* – presented by Ukraine, presented by Mr. S. Fomin (Kharkov Institute of Physics and Technology, Ukraine);
- *US status of fast reactor research and technology* - presented by Mr. R. Hill (ANL, USA);
- *Overview of OECD-NEA Nuclear Science and Data Bank Activities* - presented by Mr. J. Gulliford (OECD-NEA/NSC, Paris).

Each country representative presented updates on national nuclear policy as well as on status of design, construction and operation (if any) of national fast reactors; prospects of fast reactor research and technology development; fast reactor concepts under consideration; and the progress and status of works related to ADS activities. The OECD-NEA representative presented the NEA-NSC and the NEA Data Bank as well as the FR-related activities carried out by the NEA-NSC and its working parties.

Due to visa problems, China representative – Mr. D. Zhang - was not able to attend the meeting but provided a full presentation on *Fast reactor and ADS development in China* by Mr. D. Zhang (CIAE) which was projected and commented during the meeting.

Lively discussions took place on the various specific topics addressed in the national presentations. The discussions contributed to the clarification of the points of view of the represented Member States with regard to the status and prospects of fast reactor research and technology programmes and initiatives.

The extended summaries and the presentations of the national programmes and the OECD-NEA are reported in Annex III.

At the end of the session Mr. S. Monti gave a presentation concerning the state of the art of the IAEA activities under the project “Fast Reactor Technology Development”, with particular reference to on-going CRPs, technical meetings and workshops held in the last year, and the organization of the International Conference on Fast Reactor and Related Fuel Cycles: Safe Technologies and Sustainable Scenarios (FR13), which will take place in Paris from 4 to 7 March 2013. Mr. Montis’s presentation is also reported in Annex III. (NB: in order to save time, this presentation also covered “Discussion 3” in the agenda).

4. ON-GOING COORDINATED RESEARCH PROJECTS

The present situation of the just finished or on-going CRPs in the field of FR and ADS is summarized in the following table:

Title	Status	Actions
Analytical and Experimental Benchmark Analyses of Accelerator Driven Systems	Completed in 2010	Convene a CM with key participants to summarize the results and define content and structure of the final report
Analyses of and Lesson Learned from the Operational Experience with Fast reactor Equipment and Systems	Completed in 2010	CM for finalizing the CRP report presently under drafting by IPPE, IGCAR and IAEA (see table in paragraph 6)
Benchmark Analyses of Sodium Natural Convection in the Upper Plenum of the Monju Reactor Vessel	Active. Simulations completed in 2012	Drafting of final report underway. First full draft planned by end of 2012
Control Rod Withdrawal and Sodium Natural Circulation Tests Performed during the PHENIX End-of-Life Experiments	Active. Simulations on natural circulation completed in 2011. Final report on natural circulation under IAEA review	Approval of the TECDOC on Natural Circulation; CM to summarize the part devoted to control rod withdrawal (see table in paragraph 6)
Benchmark Analysis of an EBR-II Shutdown Heat Removal Test	Active, just started	2 nd RCM in Nov 2013 (see table in paragraph 6)

After this review by Mr. Monti, the following specific presentations were given at this meeting:

Mr. T. Sofu presented the content, objectives, participants, etc. of the just launched CRP on *Benchmark Analyses of an EBR-II Shutdown Heat Removal Test*, as well as the short term activities agreed at the 1st RCM held at ANL on 18-19 June 2012.

Mr. H. Ohira gave a presentation on the results obtained by the participants in the CRP *Benchmark Analysis of Sodium Natural Convection in the Upper Plenum of the Monju Reactor Vessel* which is very close to completion, being the final report under drafting and expected to be finalized by the end of the year. With the help of a video, he also briefly presented the open Workshop held in Tsuruga on the occasion of the 4th RCM. A full presentation on MONJU CRP results was given at the NURETH-14 Conference (Toronto, 25-30 September 2011) and will be also given at the forthcoming ICAPP-12 Conference, Chicago 25-28 June, 2012.

Mr. A. Vasile presented the main results of the part of the CRP *Control Rod Withdrawal and Sodium Natural Circulation Tests Performed during the PHENIX End-of-Life Experiments*. He described the experimental tests performed in the PHENIX reactor, as well as the results devoted to

natural circulation which will be presented in a number of papers at the forthcoming ICAPP-12 Conference, Chicago 25-28 June, 2012. The detailed results of this part of the CRP have been reported in an IAEA TECDOC which is now under review. The part of the CRP devoted to control rod withdrawal will be the object of another IAEA TECDOC. At the end Mr. Vasile also pointed out that there are other tests conducted by CEA during the end-of-life tests in the Phenix Reactor which can be of potential interest for the TWG-FR.

5. STATUS OF THE PREPARATION OF TWG-FR PUBLICATIONS

Mr. Monti presented an overview of the FR-related publications recently published, in print, under review and under drafting. The situation is as follows:

Type	Title	Status
Proceedings	Proceedings of the International Conference on Fast Reactors and Related Fuel Cycles: Challenges and Opportunities (FR09)	Published: December 2011
NES	Liquid metal coolants for fast reactors: reactors cooled by sodium, lead and lead-bismuth eutectic	In print
NES	Design features and operating experience of experimental fast reactors	In print
TECDOC	Status of Fast Reactor research and technology development	Approved, under final IAEA editing
TECDOC	BN-600 Hybrid Core Benchmark Analysis: methods to reduce calculation uncertainties of the LMFR reactivity effects	Editing & Formatting, to be approved by PC
TECDOC	Benchmark analyses on the Natural Circulation Test Performed During the PHENIX End-of-Life Experiments	Editing & Formatting, to be approved by PC
Journal	Special issue of Nuclear Engineering & Design Journal on the outcomes of the IAEA TM on Physics and Technology of Fast Reactors (Kalpakkam, Nov. 2011)	Papers under review
TECDOC	Final Report of the CRP on Benchmark Analyses of Sodium Natural Convection in MONJU Reactor Vessel	Drafting just started. First full draft: December 2012
TECDOC	Status Report of Accelerator Driven Systems Research and Technology Development	To be completed and edited: CM on 30-31 August 2012
NES	Final Report of the CRP on Analyses of and Lesson Learned from the Operational Experience with Fast Reactor Equipment and Systems	Drafting just started
TECDOC	Final Reports of the CRP on Control Rod Withdrawal Tests Performed During the PHENIX	Content and sharing of tasks for drafting to be

	End-of-Life Tests	established at the CM on 25-27 September 2012
TECDOC	Final Report of the CRP on Analytical and Experimental Benchmark Analyses of Accelerator Driven System	Drafting to be started

NES = Nuclear Energy Series; TECDOC = Technical Document; PC = IAEA Publication Committee; CM = Consultants' Meeting

Mr. Y. Ashurko briefly summarized the results of the CRP on *Analyses of and Lesson Learned from the Operational Experience with Fast Reactor Equipment and Systems*, as well as what was decided at a recent CM in order to finalize the final report. It was decided to stay with the present contributions and finalize the report by means of a second CM to be held before the end of the year (see table in paragraph 6).

Mr. D. De Bruyn gave a comprehensive presentation on the development of the study concerning the status of ADS technologies and the present situation and plans for finalizing the *Status Report of Accelerator Driven Systems Research and Technology Development*. Next CM for finalizing the report will be held end of August (see table in paragraph 6).

Finally Mr. W. Maschek presented the case and the results of the 6 phases of the CRP on BN-600. The first TECDOC (*BN-600 Hybrid Core Benchmark Analyses*) was published in 2010, the second one (*BN-600 MOX Core Benchmark Analyses: phase 4-6 of the CRP*) was recently drafted and is now under IAEA editing and formatting. Publication is expected in 2013.

6. FUTURE TWG-FR ACTIVITIES

Meetings and Workshops

Mr. Monti introduced the discussion presenting the list of IAEA FR-related events already planned for the second semester of 2012 and the whole 2013 (completion of programme & budget 2012-2013). The following table summarizes the meeting plan 2012-2013¹:

Type	Title	Venue and dates	Notes
CM	2 nd Meeting of the International Advisory Committee of the FR13 Conference	Vienna, 11 July 2011	
CM	2 nd Meeting to finalize the IAEA technical publication: Status of ADS Research and Technology Development	Vienna, 30-31 August 2012	
CM	2 nd Meeting of the International Scientific Programme Committee of the FR13 Conference: abstract selection/review	Paris, 6-7 September 2012	
CM	Meeting to discuss and summarize the results of	Vienna, 25-27	

¹ NB: the meeting plan 2012-2013 has been slightly revised – in particular as far as tentative dates - after the meeting in order to take into account some changes intervened in the following weeks

	the IAEA CRP: “Control Rod Withdrawal Tests Performed During the PHENIX End-of-Life Experiments”	September 2012	
WS	Education & Training Seminar/Workshop on Fast Reactor Science and Technology	Bariloche (Argentina), 1-5 October 2012	
CM	2nd Meeting to finalize the final report of the CRP on Lessons Learned from the Operational Experience on Fast Reactors	Vienna, 23-24 October 2012	Tentative, to be confirmed
TM	ANS Winter Meeting: special session on the IAEA Reactor Physics and Technology Development Activities	San Diego (USA), 11-15 November 2012	
TM	Annual Meeting on Fast Reactor Knowledge Preservation	Vienna, 4-6 December 2012	Tentative, to be confirmed on the basis of budget availability
CM	3 rd Meeting of the International Scientific Programme Committee of the FR13 Conference: papers’ review and programme	Vienna, week of 10 December 2012	Exact dates to be established
CM	Meeting to prepare the proposal for the new CRP: Sodium properties and design and safe operation of experimental facilities in support of the development and deployment of Sodium-Cooled Fast Reactors (SFR)	Vienna, 18-19 December 2012	Tentative, to be confirmed
TM	Meeting on Liquid Metal Reactor Concepts: Core Design and Structural Materials	Vienna, 22-24 January 2013	Tentative, to be confirmed
TM	GIF-IAEA/INPRO Interface Meeting (including status of collaboration on FR)	Vienna, 26-27 February 2013	INPRO meeting with TWGFR participation
WS	GIF-IAEA Workshop on Safety Design Criteria for SFR	Vienna, 28 Feb. – 1 Mar. 2013	In collaboration with INPRO
CN	International Conference on Fast Reactors and Related Fuel Cycles: Safe Technologies and Sustainable Scenarios (FR13)	Paris, 4-7 March 2013	Hosted by France (CEA, SFEN)
TM	Meeting on Existing and Proposed Experimental Facilities for Fast Neutron Systems	Vienna, 9-11 April 2013	Tentative, to be confirmed
TM	46 th annual Meeting of the TWG-FR	Vienna, 20-24 May 2013	
TM	Meeting on Fast Reactors with Improved Economics and Enhanced Non-proliferation Characteristics	Vienna, 11-13 June 2013	Tentative, to be confirmed

RCM	First RCM of the CRP “Sodium properties and design and safe operation of experimental facilities in support of the development and deployment of Sodium-Cooled Fast Reactors (SFR)”	Cadarache (France), 9-11 July 2013	Tentative, venue and dates to be confirmed
TR	IAEA/ICTP School on Physics, Technology and Applications of Innovative Fast Neutron Systems and Related Fuel Cycles	Trieste (Italy), 2-6 September 2013	
TM	Meeting on Fast Reactor Construction and Commissioning	Kalpakkam (India), 7-9 October 2013	Tentative, venue and dates to be confirmed
RCM	First RCM of the CRP on “Source term for radioactivity release under fast reactor core disruptive accident (CDA) situations”	Kalpakkam (India), 9-11 October 2013	Tentative, venue and dates to be confirmed
RCM	Second RCM of the CRP “Benchmark analysis of an EBR-II shutdown heat removal test”	Vienna, 5-7 November 2013	
TM	Annual Meeting on Fast Reactor Knowledge Preservation	Vienna, 3-5 December 2013	Tentative, to be confirmed

CM = Consultants’ Meeting; TM = Technical Meeting; RCM = Research Coordination Meeting; WS = Workshop; CN = Conference; TR = Education & Training School

Mr. Monti also summarized the recommendations and suggestions collected in the last year from representatives of the Member States concerning technical topics for new TMs/WS to be organized by the IAEA in 2013-2014, i.e.:

- Safety approach, regulatory framework and licensing issue/risks
- Safety standards and codes & standards
- Severe accidents, in particular impact of Fukushima accident on the safety aspects of existing and planned FRs
- Safety systems and monitoring / instrumentation
- Risks of Sodium as coolant/technology
- Under sodium viewing for ISI&R
- Priorities in modelling and simulation
- R&D facilities: status, future needs and sharing of results
- Feedback experience and direction from R&D, design, licensing, manufacturing, operation and decommissioning
- Economic impact of safety enhancements
- Fast reactor physics and technology
- Major technical and institutional requirements for advanced fast reactor systems

The following further topics were proposed at the meeting, in particular by the Indian representative Mr. Puthiyavinayagam:

- Evolving Severe Accident Scenarios
- Safety Criteria for SFR
- Seismic Design Criteria and Analysis
- Assessment of Cliff-edge effects in SFR
- Probabilistic and Deterministic Safety Analysis Methods with respect to Fukushima Accident
- Passive Safety Features of Current and Future FBRs
- Reliability Assessment of Active and Passive Safety Systems

Technical publications

The following list of already planned IAEA publications was also reviewed and discussed at the meeting:

- Monograph on "Severe Accident Management in Fast Reactors"
- Monograph on "Sodium Aerosol: Sources, Effects and Analysis"
- NE series document on SFR life time extension
- NE series document on design criteria and concepts for "core catchers"
- NE series document on instrumentation of advanced sodium cooled fast reactors
- NE series document on advances in sodium leak detection and handling of sodium fires

In addition Mr. Puthiyavinayagam also proposed the following ones:

- Seismic Design and Safety Criteria for SFR under Design and Beyond Design Basis Earthquakes
- Severe Accident Mitigation Measures in SFR
- Emergency Preparedness and Implementation
- In-service Inspection Requirements, Tools and Sensors
- Condition Monitoring of Sodium System Piping and Equipment

Coordinated Research Projects

The following CRPs were planned for implementation within the programme & budget 2012-2013 but it was not possible to launch them due to budget constraints and lack of sufficient human resources devoted to FR:

- Source term for radioactivity release under fast reactor core disruptive accident (CDA) situations
- Optimum plant parameters for metallic and MOX fuelled fast reactors
- Analyses of Fuel Melting Tests Performed During the Phénix End of Life Experimental Programme
- Analyses of Core Mechanics Tests Performed During the Phénix End of Life Experimental Programme
- Analyses of Primary Pump Seizure in a Fast Reactor Under Seismic Excitations
- Benchmarking of structural materials pre-selected for advanced nuclear reactors

In the meantime at the last TWGFR meeting in Beijing (May 2011) a new CRP proposal concerning sodium properties and sodium experimental facilities was proposed by France. The same proposal was presented again at this meeting by Mr. Latge' of CEA who gave additional information on the rationale, the objectives, the tasks' description, etc. of this new CRP whose final title is "*Sodium properties and design and safe operation of experimental facilities in support of the development and deployment of Sodium-Cooled Fast Reactors (SFR)*". After a broad discussion and request of clarifications by the participants, the following organizations expressed their potential interest in this CRP at the meeting:

- Argentina: CNEA (to be confirmed)
- Belgium: SCK.CEN (to be confirmed)
- France: CEA (proposer)
- Germany: HZDR and KIT
- India: IGCAR
- Netherlands: NRG
- Russian Federation: IPPE
- Sweden: KTH
- USA: ANL

The following new CRP proposals were also presented at the meeting:

- Benchmark exercise on neutronic calculations for a mixed-oxide fuelled core of an industrial size Sodium-cooled Fast Reactor (proposed by HZDR). This CRP is intended to investigate the start-up core of the BN-800 FR under construction in Russia. First stage of the CRP would deal with the first criticality determination under zero power condition whilst the second stage would concern the control rod position determination at full power.
- Inter-Comparison of Numerical Predictions of Drop Time Measurements of Control Rods in a Typical SFR (proposed by IGCAR; India could provide test data)
- In-vessel Imaging Technology in Sodium (proposed by IGCAR)
- Core neutronic stability of typical SFR with a reference benchmark core (proposed by IGCAR; details on this proposal can be found in the IGCAR presentation in annex III).

At the end of the session the participants agreed the following actions:

- On the basis of the discussion and proposals presented at this meeting, the IAEA Secretariat will prepare updated lists of TMs/WSSs, technical publications and CRPs;
- The lists will be distributed to the TWG-FR representatives who will be requested to indicate their priorities;
- The results of this survey will be taken into account by the IAEA in order to define the programme & budget 2014-2015 (and further) in the area of FR and ADS;
- As far as the new technical publications, it is intended that they will be the output of new Technical Meetings on the different topics;
- As far as the new CRP proposal "*Sodium properties and design and safe operation of experimental facilities in support of the development and deployment of Sodium-Cooled Fast Reactors (SFR)*", MR Latge' and Mr. Monti will revise the preliminary proposal which will be circulated to collect expression of interests and suggestions for further improvements. By

the end of the year the IAEA will organize a CM to finalize the full proposal which will be then submitted to the IAEA Committee for Coordinated Research Activities (CCRA) by the end of the year with the objective to obtain approval in spring 2013. After approval the potential participants will be invited to submit their proposal for agreements/contracts which have to be evaluated and approved by the IAEA. Therefore it is anticipated that the CRP could start with the first RCM in the second part of 2013 (hopefully in July 2013, see table at the beginning of this paragraph)

7. CONCLUSIONS AND RECOMMENDATIONS

The 45th Meeting of the TWG-FR reached the following conclusions/recommendations:

- The participants expressed satisfaction and appreciation for the large amount of new information on on-going activities carried out by the Member States in the field of FR and ADS exchanged during the meeting;
- Also the organizations which have participated to the TWG-FR meeting for the first time expressed their appreciation for the lively discussion and the results and thanked the IAEA for inviting them at the meeting;
- The meeting was very useful in particular for collecting inputs and advice in view of the preparation of the IAEA Programme & Budget 2014-2015 (and then 2016-2017) in the area of FR and ADS technology development;
- The TWG-FR remains an unique international forum for information exchange in the field of fast neutron systems and for promoting RT&D activities in this area;
- Due to the increasing interest in FR and in view of the forthcoming realizations, it would be advisable to increase the involvement of industries, regulators and other R&D organizations;
- The annual TWG-FR meeting should focused on exchange of information on national and international programmes, avoiding duplications or overlapping's with other IAEA initiatives in the field;
- Form a general point of view it is recommend to avoid duplications with other FR-related events;
- It was underlined the importance of a timely implementation of the different activities, in particular as far as the publication of the IAEA final reports;
- The CRPs are recognized as a unique mechanism of RT&D at international level and increasing effort and resources should be implemented by the IAEA in order to cover the many topics of interest of the Member States;
- In particular the following general RT&D topics are of interest for a large number of Member States:
 - ✓ Structural materials;
 - ✓ Importance to move to transient in CRP on experimental benchmark (non-linearities);

- ✓ Impact of the Fukushima accident on FRs: safety, severe accidents and initiators, stressing the advantages of LMFR;
 - ✓ Coupling methods;
 - ✓ Uncertainties evaluation methods;
 - ✓ V&V&Q and in particular validation of models with experimental data coming from facilities with advanced instrumentation;
 - ✓ In-service inspection;
 - ✓ Economic impact.
- It is recommend to take advantage of the new FR/ADS projects and realizations and organize the TWGFR activities around data coming from these new facilities/plants;
 - Particular attention should be given to Generation IV FR nuclear systems;
 - The TWG-FR should continue to secure training and education in the field of “Fast Neutron System Physics, Technology and Applications”, and respective Schools/Workshops/Seminars should be held on a regular basis;
 - Cooperation and collaboration should be promoted with the NEA-NSC, in particular in the field of reactor transient analyses.

8. MISCELLANEA

The 46th TWG-FR meeting is tentatively scheduled for 20 - 24 May 2013. Proposals for hosting this meeting are expected by the Secretariat within 2 months, otherwise the meeting will be held at IAEA-HQ in Vienna.

Mr. Monti warmly thanked the ANL for hosting the 44th TWG-FR meeting in Argonne, and also all the delegates from the TWG-FR Member States for participating and actively contributing to this meeting.

By the same token, all participants expressed their happiness and thanked for the excellent hospitality provided by ANL.



**Forty-Fifth Meeting of the
Technical Working Group on Fast Reactors (TWG-FR)**

**Argonne National Laboratory (ANL)
Argonne, IL, USA**

20-22 June 2012

ANNEX I: AGENDA

WEDNESDAY, 20 JUNE 2012

Time	Topic	Speaker
Opening Session		
09:00 – 10:50	<ul style="list-style-type: none"> • Welcome 	Mr S. Monti NPTDS, IAEA Mr R. Hill ANL, USA
	<ul style="list-style-type: none"> • Opening Remarks 	Mr. JK Park DIR-NENP, IAEA
	<ul style="list-style-type: none"> • United States R&D on Advanced Reactors 	Mr. T. O'Connor U.S. DOE
	<ul style="list-style-type: none"> • Self-introduction by the participants • Appointment of the Meeting Chair 	All Meeting Participants
	<ul style="list-style-type: none"> • Chairperson's remarks 	Meeting Chairman
	<ul style="list-style-type: none"> • Discussion and Adoption of the Agenda 	Meeting Chairman

10:50 – 11:15	Coffee Break	
<p>Progress reports on national programmes and international organizations on fast reactors and accelerator driven systems, and identification of areas and topics of interest for future cooperation within the TWG-FR framework [Approximately 20 – 30 minutes presentation including discussion by each Member State/Int. organization representative, in country name alphabetical order]. The delegates are kindly requested to bring along their full paper progress reports and the PowerPoint presentation (on electronic support) for publication in the meeting report.</p>		
11:15 – 11:45	• Presentation by Argentina	Mr O. Azpitarte CNEA
11:45 – 12:15	• Presentation by Belarus	Ms H. Kiyavitskaya SOSNY
12:15 – 12:45	• Presentation by Belgium	Mr D. De Bruyn SCK.CEN
12:45 – 13:45	Lunch	
13:45 – 14:30	• Presentation by France	Mr A. Vasile CEA
14:30 – 15:15	• Presentation by Germany	Mr W. Maschek KIT Mr B. Merk HZDR
15:15 – 15:45	Coffee Break	
15:45 – 16:45	• Presentation by India	Mr P. Puthiyavinayagam IGCAR
16:45 – 17:30	• Presentation by Italy	Mr P Agostini ENEA
17:30	End of Day 1	

THURSDAY, 21 JUNE 2012

Time	Topic	Speaker
Presentations on national programmes and international organizations... continued		
09:30 – 10:00	<ul style="list-style-type: none"> • Presentation by Japan 	Mr H. Ohira JAEA
10:00 – 10:30	<ul style="list-style-type: none"> • Presentation by Korea, Republic of 	Mr Y. Kim KAERI
10:30 – 11:00	<ul style="list-style-type: none"> • Presentation by the Netherlands 	Mr F. Roelofs NRG
11:00 – 11:30	Coffee Break	
11:30 – 12:00	<ul style="list-style-type: none"> • Presentation by Russian Federation 	Mr Y. Ashurko IPPE
12:00 – 12:30	<ul style="list-style-type: none"> • Presentation by Sweden 	Mr J. Wallenius KTH
11:00 – 11:30	<ul style="list-style-type: none"> • Presentation by Ukraine 	Mr S. Fomin Kharkiv Institute
11:30 – 12:00	<ul style="list-style-type: none"> • Presentation by USA 	Mr. R. Hill ANL
12:00 – 12:30	<ul style="list-style-type: none"> • Presentation by OECD/NEA 	Mr J Gulliford OECD/NEA
12:30 – 14:00	<ul style="list-style-type: none"> • Report of the TWG-FR Scientific Secretary (<i>summary of TWG-FR activities, status of the actions, FR13 Conf., etc.</i>) (<i>Working Lunch</i>) 	Mr. S. Monti NPTDS, IAEA
Discussion 1: On-going Coordinated Research Projects		
14:00 – 14:30	<ul style="list-style-type: none"> • Benchmark Analysis of Sodium Natural Convection in the Upper Plenum of the Monju Reactor Vessel (2008 – 2012) 	Mr. H. Ohira JAEA, Japan
14:30 – 15:00	<ul style="list-style-type: none"> • Benchmark Analyses on the Natural Circulation Tests performed during the PHENIX End-of-Life Experiments (2009 – 2012) 	Mr. A. Vasile CEA, France
15:00 – 15:30	<ul style="list-style-type: none"> • Benchmark Analyses of an EBR-II Shutdown Heat Removal Test 	Mr. T. Sofu ANL, USA
15:30 – 16:00	Coffee Break	
Discussion 2: Status of the preparation of TWG-FR publications		
16:00 – 16:15	<ul style="list-style-type: none"> • Proceedings of the International Conference on Fast Reactors and Related Fuel Cycles (FR09) • Status Report on FR Research and Technology Develop. • Liquid Metal Coolants for Fast Reactors • Design Features and operating Experiences of Exp. FRs 	Mr. S. Monti NPTDS, IAEA
16:15 – 16:30	<ul style="list-style-type: none"> • Analyses of, and Lessons Learned from the Operational Experience with Fast Reactor Equipment and Systems 	Mr. Y. Ashurko IPPE, RF
16:30 – 16:45	<ul style="list-style-type: none"> • Status Report on Accelerator Driven Systems: Energy Generation and Transmutation of Nuclear Waste 	Mr. D. De Bruyn SCK.CEN, Belgium

16:45 – 17:00	<ul style="list-style-type: none"> • BN-600 MOX Core Benchmark Analyses (Phase 4 and 6 of the CRP on updated Codes and Methods...) 	Mr W. Maschek KIT, Germany
Discussion 3: TWG-FR Meetings within the framework of IAEA's Program and Budget 2011 - 2012		
17:00 – 17:30	<ul style="list-style-type: none"> • Main outcomes of the TMs on FRs held in 2011 -2012 	Introduction by Mr S. Monti All Meeting Participants
18:30	Meeting Dinner	

FRIDAY, 22 JUNE 2012

Time	Topic	Speaker
Discussion 4: Future (beyond 2012) TWG-FR Activities		
09:00 – 10:30	<ul style="list-style-type: none"> • Proposals for new CRPs, TMs, symposia/seminars, identification of possible NE Series Documents on topics relevant to the TWG-FR work scope (<i>To ensure distribution among all participants, the delegates are kindly requested to inform the Scientific Secretary ahead of the meeting of intended proposals</i>) 	Introduction by Mr S. Monti All Meeting Participants
10:30 – 11:00	Coffee Break	
11:00 – 14:00	<ul style="list-style-type: none"> • Proposals for new TWG-FR activities... continued (<i>includes working lunch</i>) 	All Meeting Participants
Closing Session		
14:00 – 15:30	<ul style="list-style-type: none"> • Conclusions and recommendations of the 45th TWG-FR Meeting 	All Meeting Participants
15:30 – 16:30	<ul style="list-style-type: none"> • Drafting of the Meeting Report 	Mr S. Monti with the support of All Meeting participants
16:30 – 17:00	Coffee Break	
17:00 – 17:30	<ul style="list-style-type: none"> • Date and venue of next TWG-FR Meeting • Closing Remarks 	Meeting Chairman and IAEA
17:30	End of the Technical Meeting	

ANNEX II: LIST OF PARTICIPANTS

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ANNEX III: PAPERS AND PRESENTATIONS PROVIDED BY THE
MEMBERS STATES AND THE IAEA



Participants at the 45th Technical Meeting of the TWG-FR.
Argonne National Laboratory, USA, 20-22 June 2012