

IAEA Coordinated Research Project (CRP) on “Analyses of and Lessons Learned from the Operational Experience with Fast Reactor Equipment and Systems”

A. Background Situation Analysis

Over the passed four decades, several countries had important fast breeder reactor development programs. Fast test reactors (Rapsodie (France), KNK-II (Germany), FBTR (India), JOYO (Japan), DFR (UK), BR-10, BOR-60 (Russia), EBR-II, Fermi, FFTF (USA)) were operating in several countries, with commercial size prototypes (Phénix, Superphénix (France), SNR-300 (Germany), MONJU (Japan), PFR (UK), BN-350 (Kazakhstan), BN-600 (Russia)) just under construction or coming on line. However, from the 1980s onward, and mostly for economical and political reasons, fast reactor development in general began to decline. By 1994, in the USA, the Clinch River Breeder Reactor (CRBR) had been cancelled, and the two fast reactor test facilities, FFTF and EBR-II had been shutdown - with EBR-II permanently, and FFTF, until recently, in standby condition, but now also facing permanent closure. Thus, in the U.S., effort essentially disappeared for fast breeder reactor development. Similarly, programs in other nations were terminated or substantially reduced. In France, Superphénix was shut down at the end of 1998; SNR-300 in Germany was completed but not taken into operation, and KNK-II was permanently shut down in 1991 (after 17 years of operation) and is scheduled to be dismantled by 2004. In the UK, PFR was shut down in 1994, and in Kazakhstan, BN-350 was shut down in 1998.

At the same time that the interest in the fast reactor waned, also the retirement of many of the developers of this technology reached its peak, between 1990 and 2000, and hiring diminished in parallel. In parallel, the facilities (e.g., hot cells, fuel fabrication and inspection lines, seismic test rigs, and so forth) are drifting into a degraded state or are being shut down. All this leads to conclude that the continuity in the capacity to deploy fast reactor technology is in jeopardy. Hence, there is a need to preserve fast reactor technology until the economic need for fast breeder reactors, which may not occur for three or more decades, becomes apparent.

In response to expressed needs by Member States, and within a broader Agency wide effort in nuclear knowledge management, preservation and transmission to the young generation, the IAEA is implementing a concrete initiative on fast reactor data retrieval and knowledge preservation. The Agency’s initiative provides an overall framework for the various programs being implemented in the Member States to stop data and information being destroyed, retrieve the data, assess its importance, determine what data and information should be retained, how information from different programs could be linked, how the quality of information should be assessed, and what standards should exist in software and hardware for preservation over the next 30 to 40 years. Provided funding is ensured, it will support and coordinate data retrieval activities, and establish the portal for accessing the knowledge base. By addressing issues of “institutional memory” (through, e.g., retrieval and preservation of the decision making processes, including the “false trails” followed and eventually rejected) and of passing information from one generation to the next, it aims at more than collecting

information on static Web-based databases. In addition to the concrete steps for implementing the data retrieval and archiving activities (e.g., IAEA fact-finding missions to interested Member States joining the initiative to mobilize Member States to take concrete action, identification the key experts and in some cases, provided funding is available, securing the experts' collaboration under the provision of "Special Service Agreements", ensuring effective follow-up of the actions and commitments), the IAEA will also organize coordinated research projects on specific topics of relevance to fast reactor knowledge preservation issues.

The participants in the 36th meeting (Daejeon, Republic of Korea¹, 2-14 May 2003) of the Technical Working Group on Fast Reactors (TWG-FR), recognizing the importance of preserving and generalizing the experience from fast reactor operation and decommissioning, recommended the implementation of a CRP on this topic within Agency's programmatic framework, and put an action on the TWG-FR Scientific Secretary to formulate and submit the CRP proposal.

The CRP will be implemented as a collaborative activity between the projects "Technology Advances in Fast Reactors and Accelerator Driven Systems (ADS)" and "Maintenance and Preservation of Knowledge in Specific Areas of Nuclear Science and Technology".

The CRP will further collaborate with the Department of Nuclear Safety and Security (NS); more specifically, interact with and welcome the involvement of the Division of Nuclear Installation Safety (NSNI).

B. Overall Objective

The CRP will contribute to the preservation of the feedback ("lessons learned") from the commissioning, operation, and decommissioning of experimental and power sodium cooled fast reactors.

C. Specific Research Objective

The specific objectives of the CRP are to

- Preserve the feedback from commissioning, operation, and decommissioning experience of experimental and power sodium cooled fast reactors
- Enable easy access to the information from this feedback
- Produce lessons-learned/synthesis reports of lessons learned from the commissioning, operation, and decommissioning of experimental and power sodium cooled fast reactors.

To achieve these objectives, the CRP participants will retrieve, assess and archive all the documentation and information relevant to feedback from commissioning, operation, and decommissioning of sodium cooled fast reactors. The archiving step will include conversion of the documents in electronic form and the preparation of electronic databases organized along scientific/technical topics and reactors.

In the next step, the CRP will work on the critical review, assessment, and systematization of the available data, and will publish synthesis reports, including the appropriate recommendations from the “lessons learned”. It is important to stress that these generalization efforts are crucial in view of the generational change occurring now: preserving the knowledge and experience of the generation who participated in the initial development work of sodium cooled fast reactors and is now retiring, and ultimately ensuring the systematic use of the operational feedback in the form of a “lessons learned” approach, is essential since it was in the early stage of the studies that the key decisions and design choices were made. To accomplish the lessons-learned and synthesising work requires for as many as possible of the highly skilled specialists and pioneers in the sodium cooled fast reactor research and development area to be actively involved in the CRP.

The following is a first attempt to give a prioritized list of the topics of interest for this CRP:

- Steam Generators
- In-Service Inspection and Repair
- Reactor Physics Start-up Experiments
- Cleaning and Repair of Components (liquid-metal wetted)
- Sodium Purification Systems
- Decay Heat Removal System Performance
- Sodium Leak Detection (general)
- Sodium Leak Detection in Steam Generators
- Fuel Handling
- Detection of Failed Fuel
- Shutdown Systems, including Drive Mechanisms
- Cover Gas Cleanup Systems
- Operation with Failed Fuel
- Forced Reactor Outages (Cause and Recovery)
- Treatment of Residual Sodium in Maintenance and Decommissioning
- Fast Neutron Monitoring Systems

D. Expected Outputs (Results)

The output from the CRP will be a final report(s) (IAEA Technical Report(s)) summarizing the results of the data retrieval and archiving work, as well as the results of the synthesis efforts, of lessons learned and recommendations. At the same time, the IAEA will host the databases that will be produced in the course of the CRP, and make them accessible through the Agency’s nuclear knowledge management portal currently under development.

E. Action plan (Activities)

Member States with passed and/or ongoing fast reactor programmes will be invited to participate in the CRP. The following institutes in Member States and international organizations have informally indicated their interest in participating:

China	China Institute of Atomic Energy
France	Commissariat à l'Energie Atomique CEA
Germany	Forschungszentrum Karlsruhe FZK
India	Indira Gandhi Centre for Atomic Research
Japan	Japan Nuclear Cycle Development Institute JRC
Rep. of Kazakhstan	MAEK
Rep. of Korea	KAERI
Russian Federation	State Scientific Centre Institute of Physics and Power Engineering (IPPE) Obninsk
UK	BNFL
USA	ANL

OECD/NEA, Paris

The estimated duration of the CRP is 4 years. Following the establishment, in 2004, of an international team by putting in place research agreements and contracts, the following activities will be undertaken to achieve the outputs expected from the CRP:

- I. Convene a preparatory Technical Meeting (TM) in January 2005 to discuss the accumulated operational feedback with the various sodium cooled fast reactors, exchange information on the various approaches to archiving, and converge on the list of reactors and topics of interest for the CRP.
- I. Convene, in 2005, the 1st (kick-off) research coordination meeting (RCM) to agree upon the list of reactors to be considered and upon the topics to be covered by the CRP, identify lead organisations among the CRP participants for the various topics/work packages, produce an agreed upon definition of detailed tasks as well as work plans and deadlines, identify responsibilities for competing tasks, and to establish an outline and responsibilities for completion of the final IAEA TECDOC(s) that will report the results of the CRP.
- II. Convene, in 2006 and 2007, respectively, the 2nd and 3rd RCMs to review progress to technical work and TECDOC development, and identify needed improvements and/or modifications to the tasks and/or work plans.
- III. Convene the 4th RCM in 2008 to review the status of the technical work and perform an overall review of the CRP results, provide the final input to the TECDOC(s) and finalize the draft of the TECDOC, identify open issues and actions to resolve them, and outline the road ahead and the Agency's role.