

Status of Fast Reactors and Accelerator Driven Systems Technology

Lecture presented at the ICTP/IAEA Workshop on
**Nuclear Reaction Data and Nuclear Reactors:
Physics, Design and Safety**

25 February -28 March 2002, Miramare – Trieste, Italy

Alexander Stanculescu

Division of Nuclear Power

Nuclear Power Technology Development Section

International Atomic Energy Agency (IAEA)

14 March 2002

Vienna, Austria

Outline

- Fast reactors
 - Operation
 - Ongoing research & development
- Accelerator driven systems (ADS)
 - Radioactive waste
 - ADS technology example (Energy Amplifier)
 - ADS research & development
 - Partitioning and transmutation (P&T) open questions
 - IAEA's role and activities
 - Conclusions

Status of Fast Reactors (FR), 1/3

- Main goal: energy production & breeding
- Additional incentives
 - Reduce actinide content in waste
 - Take advantage of high thermal efficiency

Status of Fast Reactors (FR), 2/3

- Operation of FR (demonstration/prototype and commercial size)
 - BN-350 (commissioned '64, first electr. '73, potable water production, perm. shut down '98)
 - BN-600 (commissioned '67, first electr. '80)
 - PFR (commissioned '66, first electr. '75, perm. shut down '94)

Status of fast Reactors (FR), 3/3

- MONJU (commissioned '85, first electr. '95, shut down since '95, Na leak in sec. system)
- Phénix (commissioned '68, first electr. '73, life extension till ~ 2007)
- Superphénix (commissioned '76, first electr. '86, perm. shut down '98)

FR Development Activities, 1/3

- China
 - CEFBR (25 MWe, under construction, 1st criticality scheduled for 2005)
 - MPFR (300 MWe, under consideration, energy production and transmutation goals)
- France
 - Generic, long-term R&D
 - Reference: gas cooled FR with on-site closed fuel cycle



14 March 2002

CEFR Site

FR Development Activities, 2/3

- India
 - PFBR (500 MWe): design, R&D, manufacturing technology development
- Japan
 - Efforts to restart MONJU
 - “Feasibility Study on Commercialised FR Cycle Systems” ongoing
 - Will be followed by a specific program for FR demonstration

FR Development Activities, 3/3

- Republic of Korea
 - KALIMER (150 MWe): conceptual & basic design finalized by '02 & '06, resp.; feasibility of construction to be examined in mid 2010s
- Russia
 - BN-800 (startup scheduled for 2010)
 - Development of advanced FR (large MOX, Na cooled FR, Pb cooled BREST concepts with nitride fuel, and Pb/Bi cooled concepts)

Radioactive waste generated in nuclear fuel cycles, 1/4

- Depleted uranium represents ~95% of the spent fuel
- Plutonium & minor actinides (TRansUranics, TRU's) represent ~1.1% of the spent fuel, and are the result of neutron capture and subsequent decay: $n + {}^{238}\text{U} \rightarrow {}^{239}\text{U} (t_{1/2} \sim 23 \text{ m}) \rightarrow {}^{239}\text{Pu}, \text{ etc...}$
- Fission products represent ~4% of the spent fuel