GEN IV International Forum℠
Expertise | Collaboration | Excellence

Phenix and Superphenix Feedback Experience

Summary / Objectives:

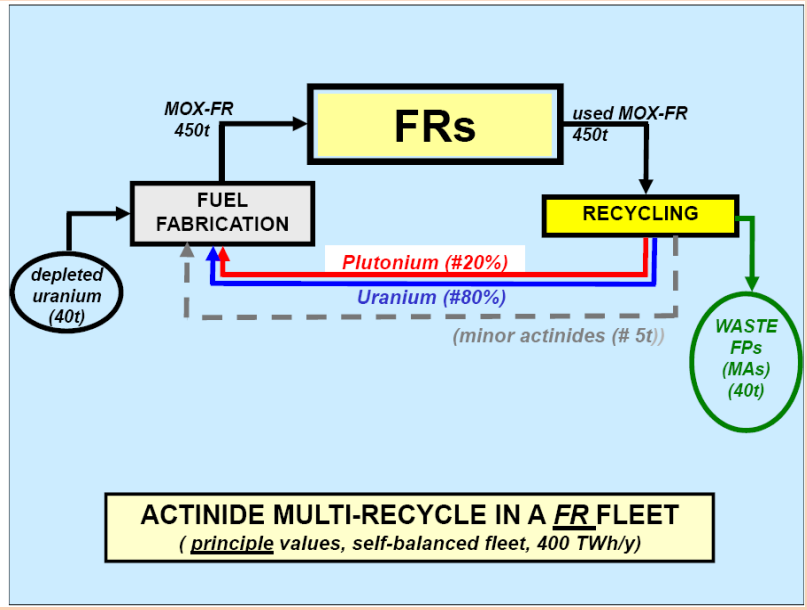
France energy situation is specific : no fossil energy available (oil, coal, gas, etc..), a large fleet of PWR in operation providing about 80% of electricity , and a successful reprocessing activity providing each year about 10 tons of plutonium. In this situation, sodium fast breeder reactors would be very useful for the country, and have been developed with the Rapsodie, Phenix and Superphenix reactors. The feedback experience of these reactors has been analyzed and collected in two books “Phenix: the feedback experience” / EDP sciences 2012, and “Superphenix: Technical and Scientific achievements” / Springer 2016. This thematic analysis was performed on materials, fuel, neutronic, thermal hydraulic, components, water sodium reaction, sodium leaks, safety, and more generally on all the specific technical matters related to this type of reactor. The presentation gives, for each theme cited above, the main results obtained and the main conclusions or recommendations for the future of sodium fast breeder reactors.

Meet the Presenter:

Joël Guidez began his career in the field of sodium-cooled fast reactors, after graduating from the Ecole Centrale de Paris in 1973. He worked at Cadarache for eight years on the design, dimensioning and testing of sodium components for Superphénix. He also followed the initial results, from the Phénix sodium-cooled fast reactor start-up in 1974. Then he joined Phénix where, for five years, he was in charge of measurements and tests on the power plant. In 1987, he returned to Cadarache to lead a thermo-hydraulics laboratory, where many tests were performed for Phénix, Superphénix and the European Fast Reactor (EFR) project. After a period of apparent unfaithfulness to fast reactors, during which he successfully managed the OSIRIS research reactor located in Saclay, and the European Commission’s reactor, HFR located in the Netherlands, he returned to Phénix in 2002, where he managed the reactor until 2008 during his final operating phase. Since 2011, he is considered as international expert in CEA and wrote two books: “Phenix feedback experience” Editor EDP Sciences and “Superphenix. Technical and scientific achievements” editor Springer.

1. Objectives of fast breeder reactors:

- Uranium availability
- Plutonium management
- Management of REP waste
- Transmutation possibilities
- Optimized fuel cycle



2. Sodium fast breeder experience in the world

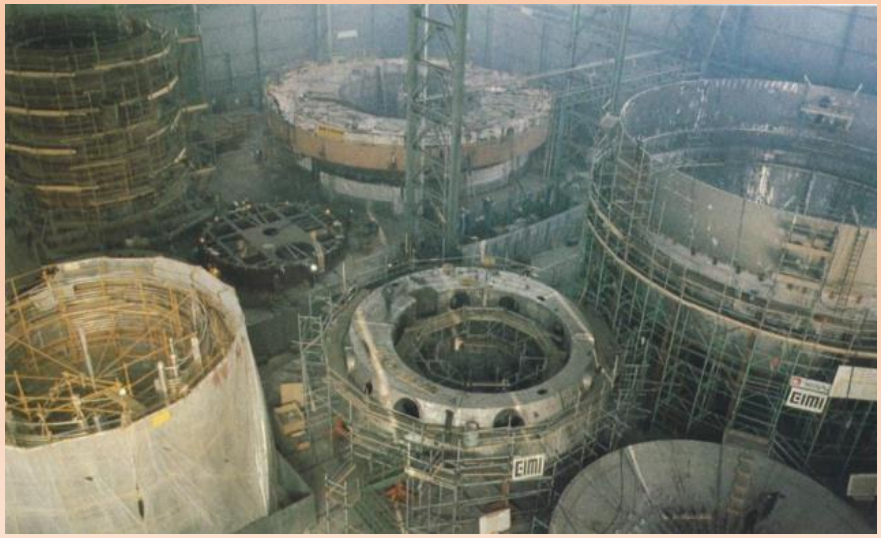
- The first nuclear reactor to produce electricity was a sodium (NaK) reactor in 1951.
- 20 SFR have been built and operated in the world.
- USA/ Russia/ France/ Japan/ India/ China/ UK/ Germany.
- The last one is BN 800 (Russia /800 Mwe) connected to the grid in 2016.
- The PFBR (India /500 Mwe) should start in 2018.

3. Phenix feedback experience

- Built in 1968, by an integrated CEA/EDF/GAAA team, it went critical in 1973 and was co operated with EDF (80% CEA / 20% EDF) from 1974 to 2009.
- During the thirty five year life span, it played its dual role as electricity generator (250 MWe) and experimental research reactor. Thus , it gathered considerable experience for fast breeder reactor systems: demonstration of design and operation , breeder potential, transmutation possibilities, development of all technical fields involved and validation of the technology used.

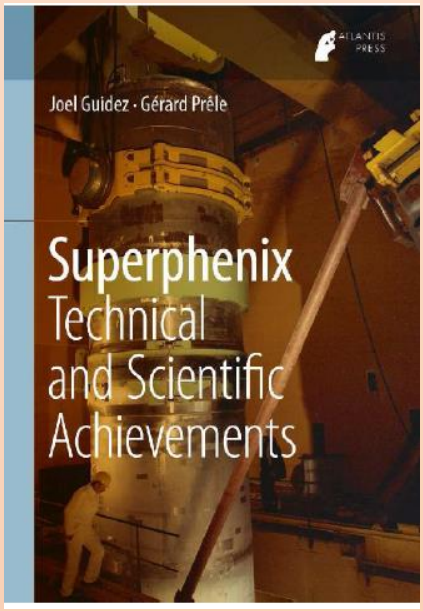
4. Superphenix: technical and scientific achievements

- A huge industrial experience was acquired during the reactor construction.
- The reactor was built in seven years , from 1977 to the beginning of sodium filling sodium in1984.
- The nominal power was reached in December 1986.
- Despite a complicated political life, a big experience on all the technical fields was also acquired until the reactor shut down ten years later.



5. Thematic analysis

- Two books have been written to try to summarize this experience.
- The books are not organized around a chronological experience but with thematic analysis.
- The main themes studied are neutronic , materials , components, thermalhydraulic , fuel, handling, and maintenance.



6. Some examples of accumulated experience

- Reprocessing experience on Phénix (because it is an industrial experience unique in the world)
- SPX construction (impressive industrial work)
- Neutronic of SPX core (the most powerful SFR core ever operated / it remains today a very interesting case for all neutronic studies)