GEN IV International Forum
Expertise | Collaboration | Excellence

Astrid - Lessons Learned

Summary / Objectives:

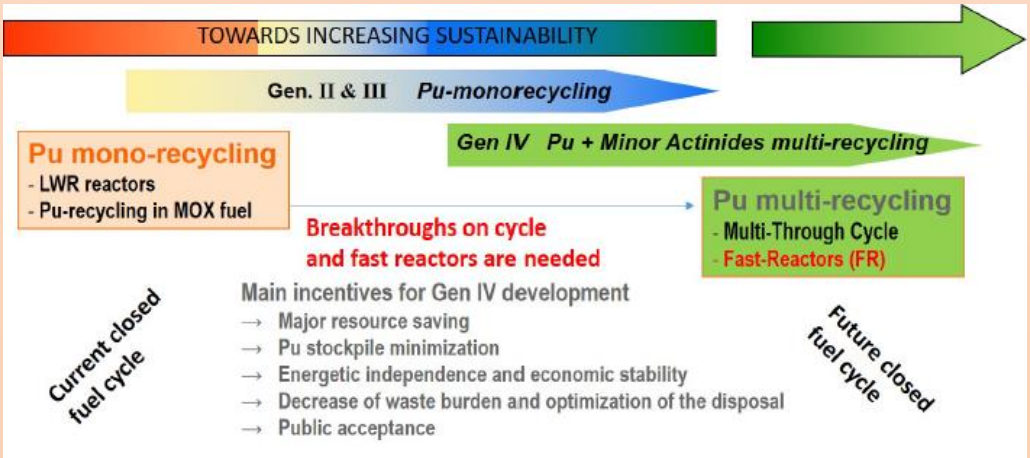
This presentation will first place the context of the choice of Sodium Fast Reactor in the French Nuclear Policy and its rationale for a closed fuel cycle. It will then present the position of the French Sodium Fast Reactor program in the context of Generation IV. The presentation will then focus on the ASTRID (Advanced Sodium Technological Reactor for Industrial Demonstration) project. The technical achievements, major innovation progress and management challenges will be presented. The ASTRID project description will highlight the major use of digital tools (numerical simulation, use of virtual reality, multiscale and multi-physics modeling, PLM: Product Lifecycle Management) used to perform efficiently such a complex project.

Meet the Presenter:

Mr. Gilles Rodriguez is a senior expert engineer at the CEA/CADARACHE (French Atomic Energy Commission/Cadarache center). Since 2016, he has also been the deputy head of the ASTRID Project team, working on Generation-IV Fast Reactor research program. He graduated from the university of Lyon, France in 1990 with an engineering degree in Chemistry and obtained a Master of Science in chemical and process engineering from the Polytechnic University of Toulouse, France, in 1991. His areas of expertise are fast reactor technology, liquid metal processes, and process engineering. From 2007 to 2013, he was Project Leader of sodium technology and components, within the CEA SFR project organization. In 2013, he joined the CEA project on Sodium Fast Reactor: ASTRID (Advanced Sodium Technological Reactor for Industrial Demonstration), first as responsible of the ASTRID Nuclear Island.

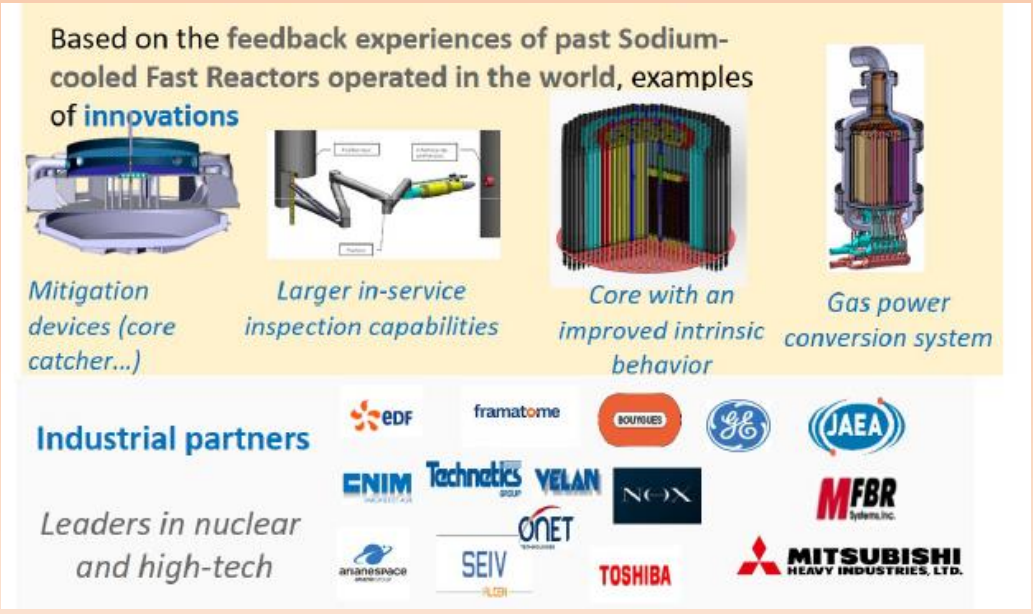
1. French Nuclear Policy:

- The French Multi-annual Energy Plan (MEP) is updated every 5 years. An update will be issued at the end of 2018, after the on-going public debate. The governmental document issued to support the public debate on energy has confirmed the closed fuel cycle strategy, as it allows for Pu management and ensures sustainability of nuclear energy.
- Reference of the French roadmap is based on the reprocessing of oxide fuel (hydrometallurgy) and the use of Fast Reactors. Priority is given to Sodium-cooled Fast Reactors (most mature technology). Active survey is performed on other technologies through collaborations.



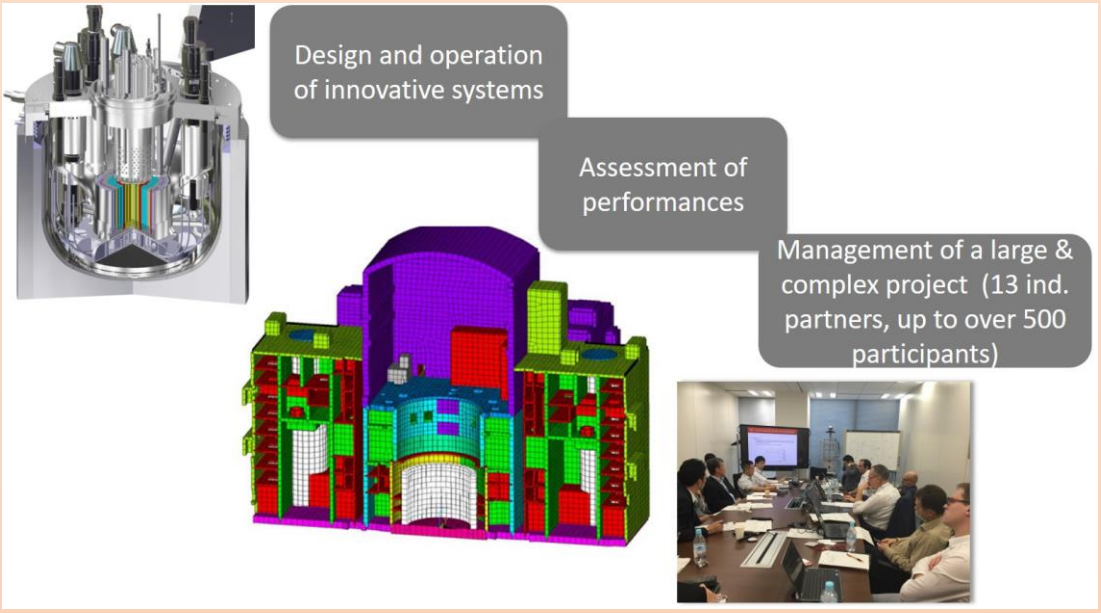
2. The ASTRID Program

- ASTRID is a technological demonstrator and is not a First of a Kind of a commercial reactor.
- The technology of ASTRID allows to have a very resilient design to external events (earthquake, flooding, loss of power, airplane crash…).



3. Use of Digital in ASTRID Project

- Model Complex Phenomena to Consolidate Demonstrations
- Management of a Large Complex Project
- Advantages From the Use of Virtual Reality Description



4. Main Achievements for 2015

- A synthesis file was sent to the government mid 2015
- Strategy leading to the choice of Gen IV sodium cooled fast reactor and closed fuel cycle.
- Synthesis file summarizing the conceptual design phase (2010-2015) provided in December 2015
- Scope statement, with technological choices (including conversion system), issued from Conceptual Design.
- Workplan for Basic Design, with associated R&D infrastructures.

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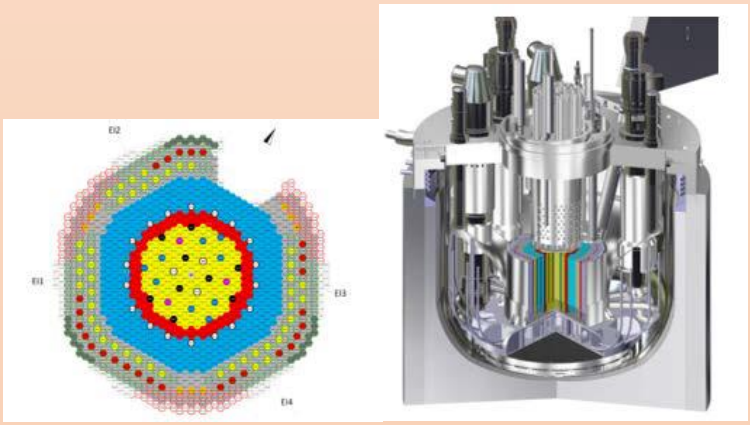
5. ASTRID Main Technical Choices

- 1500 thMW - ~600 eMW
- Pool type reactor
- With an intermediate sodium circuit
- CFV core (low sodium void worth)
- Oxide fuel UO2-PuO2
- Preliminary strategy for severe accidents
- Redundant and diversified decay heat removal systems
- Fuel handling in sodium + combination of internal storage and small external storage



6. Lesson Learned

To make to fulfill the Gen IV requirements, the new safety demonstration that we need to have, and also the cost investments that we have to reduce, it needs to get a close relationship between industry and design teams on one hand and the R&D teams on the other hand.

- SFR is a mature technology because many SFR reactors built from the 50's to the 70's were then operated. But the gap to achieve a GenIV concept is significant because GenIV is requesting improvements mainly in safety, operational and economics aspects; and it is impacting the related design.
- Even if mature, the SFR technology is not obvious and in that field knowledge preservation and transmission to the coming young generation is also a key challenge if you want to keep this key technology available for decades. Thus the use of sodium as coolant – as for the other liquid metal or Helium coolants – needs courses, practice and skills.
- Innovation is the way to design new reactors. It needs to get a close relationships between industry and design teams in one hand and R&D teams on the other hand. The role of the ASTRID Team project is to make them run together.
- SFR reactor design cannot be achieved without international collaboration, mainly to mutualize technological platforms and infrastructures. It is a win-win cost savings approach