Fuel Cycle Simulation Tools and Physical Models (1/2)

29/06/2021 - Introduction
Xavier Doligez

Fuel Cycle Simulation Tools and Physical Models (1/2)
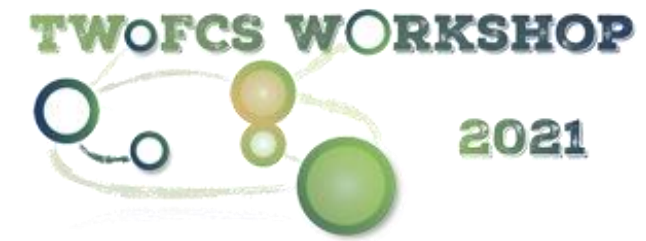
➢ <u>Back to yesterday's session :</u>

- Why ? Who are we talking to ? What kind of outputs ? How ?
  - → *Politics, stakeholders, decision makers, students, physicists,…*
  - → *Based on the physical analysis of a complex system*

- Back to Paris 2018 : why are we developing fuel cycle simulation software ?
  - → *Master models, biases, uncertainties,…*
  - → *Integrate our competences, build a community,…*
  - → *Complexity in accordance with goals (from spreadsheets to very complex software)*

- Since the first TwoFCS, software development and specificities have dedicated sessions
  - → TwoFCS Paris 2016 : COSI6, ANICCA, CLASS, CYCLUS, Tr_Evol, DANESS, COSAC, FANCSEE, MIXOPTIM…
  - → TwoFCS 201x : DYMOND, ORION, VISION, COSI7,…
  - → *TwoFCS 2021 : updates and new comers*

Tomohiro Okamura

TWOFCS WORKSHOP

2021

➢ <u>TwoFCS 2018 :</u>

   → "Understanding the behavior of a fuel cycle begins with understanding the physics in the reactor core" - *Brent Dixon*

   - Great effort to reactors models / Precise description of the isotopic evolution during irradiation

   → **Irradiation Model : Calculation spent fuel composition**

     ✓ Resolution of Bateman's equations :

$$\frac{dN_i}{dt} = \sum_j N_j R_j \sigma_j^{j \to i} \phi + \sum_j \lambda_j^{j \to i} N_j - N_i \sigma^{abs} \phi - \lambda_i N_i$$

$$\underbrace{\hspace{6cm}}_{\text{Apparition}} \qquad \underbrace{\hspace{4cm}}_{\text{Disappearance}}$$

   → **Fuel Loading Model : Calculation of the fresh composition function of:**

     ✓ Reactor parameters

     ✓ Fissile isotopic compositions (coming from spent fuel)

Barbara Vezzoni

Fissile ??   %***Fissile* ??**   ***Reactor***
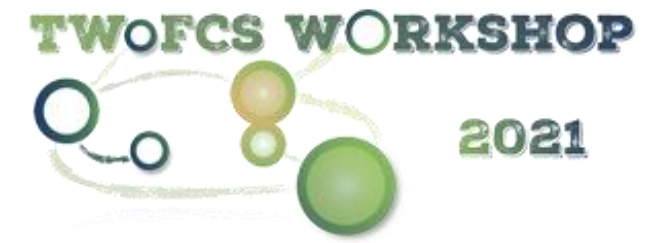
Fertile   **Fresh Fuel**   **Spent Fuel**
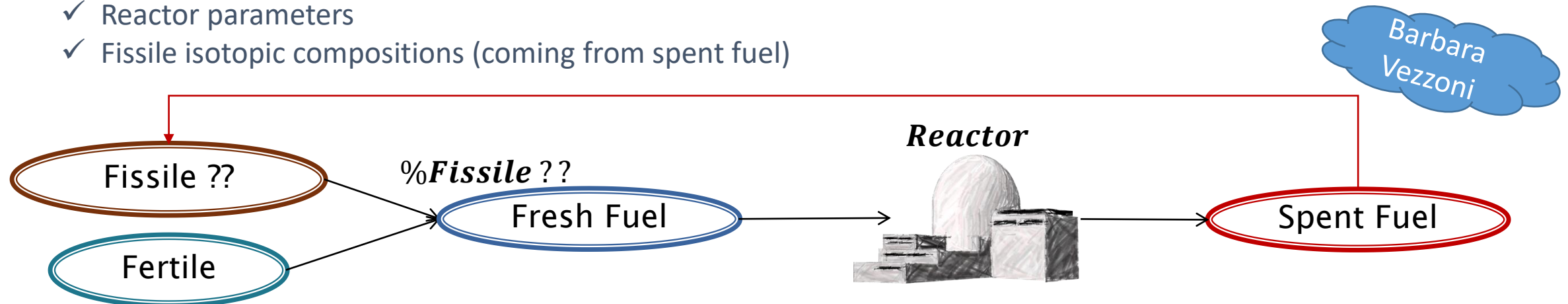
➤ From reactor simulations to scenario studies :

 → Fuel cycle simulations used for system potentialities, and performance assessments
 Plutonium management, Minor actinide transmutation, Uranium savings,…
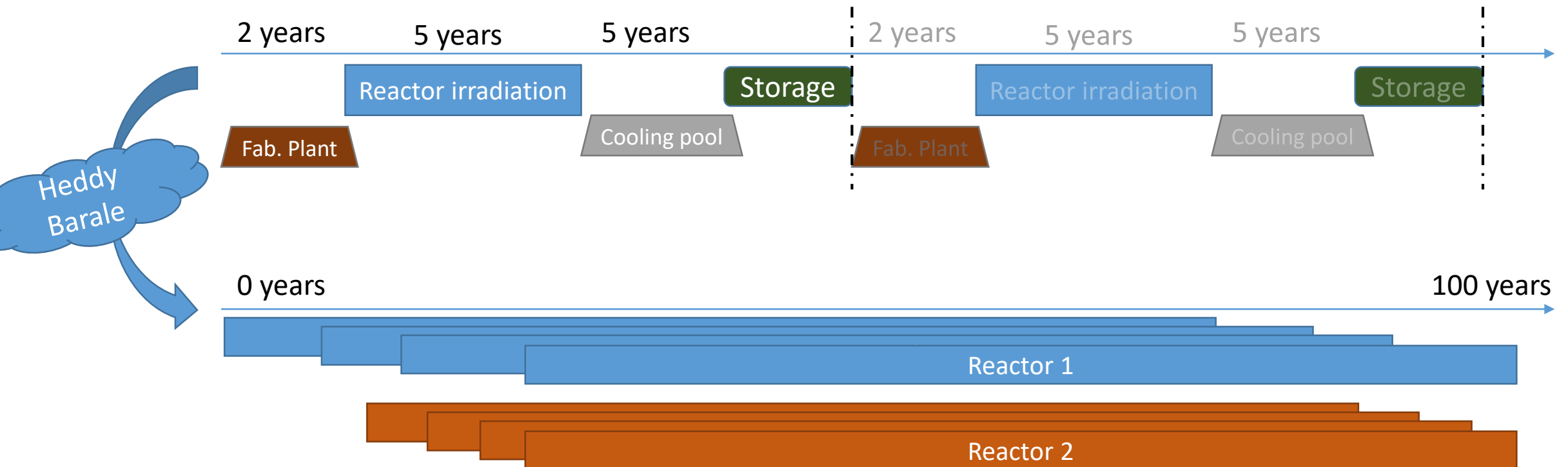
➤ Towards a simultaneous optimization of fuel cycles and reactor designs :

➢ This sessions :

➔ 9h15 - Tomohiro Okamura : **Development of nuclear fuel cycle scenario code "NMB4.0" for integral analysis from front to back end of nuclear fuel cycle**

➔ 9h45 - Heddy Barrale : **Simulation and validation of different nuclear fleets at equilibrium**

 Coffee break

➔ 10h30 - Barbara Vezzoni : **The CORAIL-A option for recycling plutonium in PWR: overview of the latest investigations at Framatome**

➔ 11h00 - Kévin Tirel : **Coupling fast reactor design and scenario calculations: a new methodology applied to scenario optimization**

➢ Topic for discussions :
- Link between fuel cycle studies and reactor simulations in different institutions ?
- Numerous fuel cycle simulators : strength or weakness ?
- Goals for fuel cycle developments ? Precise vs flexible ?
- How to cope with trust issues ?