Research and Test Reactor Fuel Reprocessing at AREVA NC La Hague plant

RRFM 2006 – Sofia

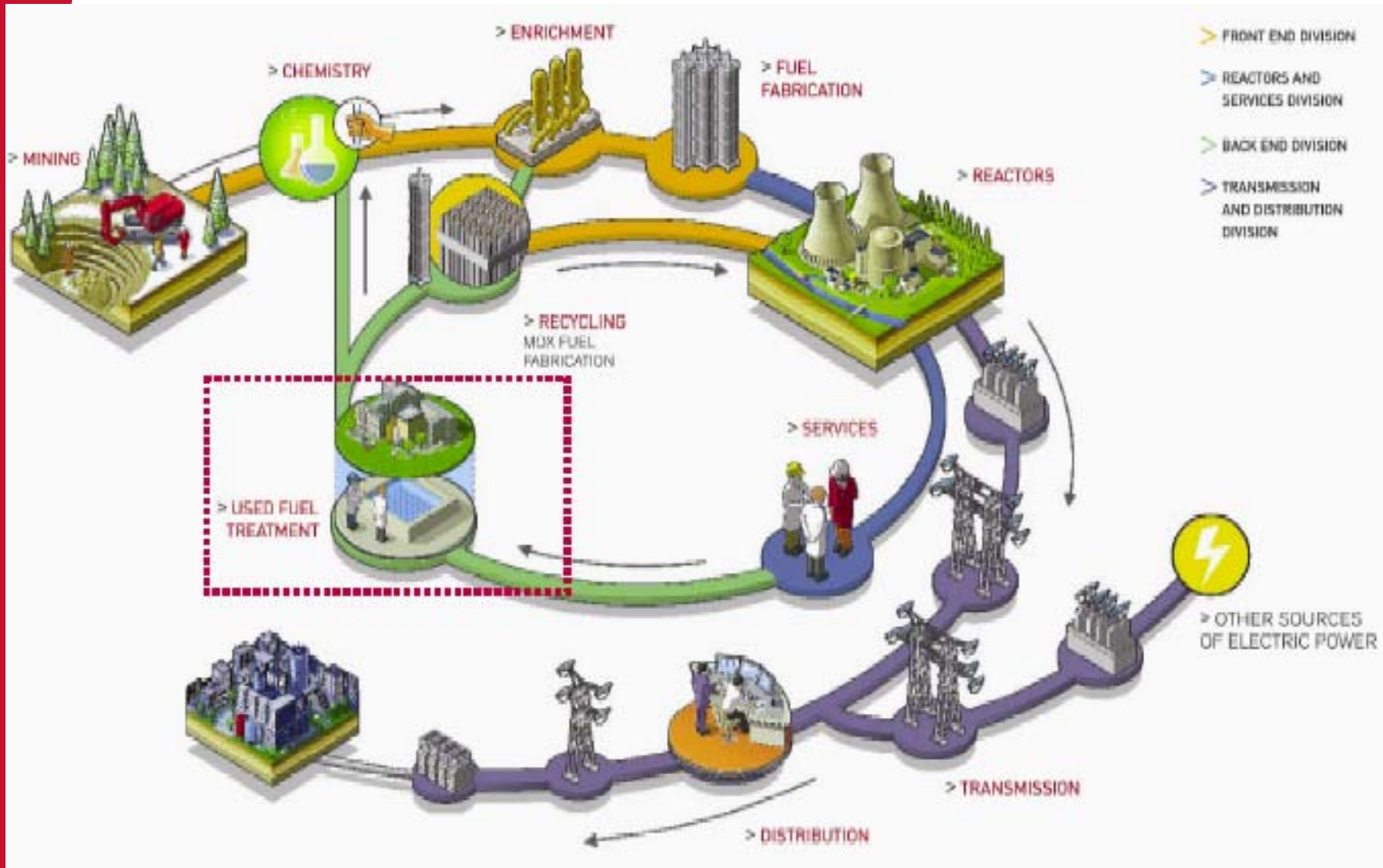
2nd May 2006

Contents

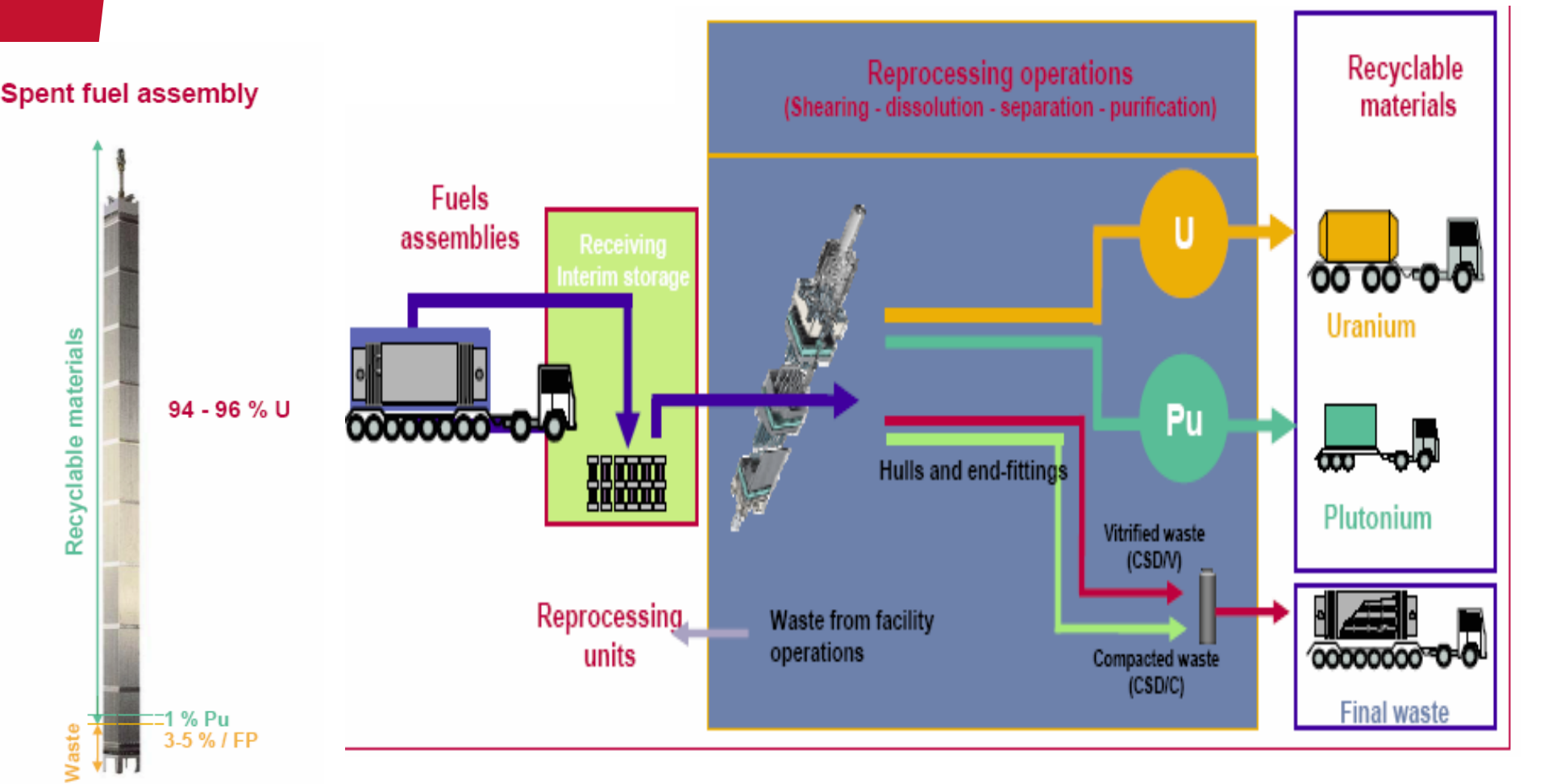
Reprocessing a solution for RTR spent fuel

- **Reprocessing**
  - **reduces the volume of High Level Activity Wastes by a factor of 30 to 50**
  - **reduces radiotoxicity**
  - **Vitrification of the residues provides a package that has been specifically designed to ensure excellent durability for long term interim storage as well as final disposal**
  - **Offers solutions to proliferation risk by down- blending HEU to below 2% enrichment**
- **Reprocessing recycles all valuable materials contained in spent fuel**

Principles of reprocessing



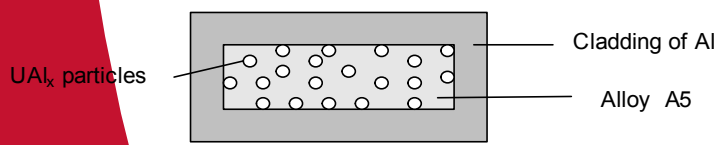
Principles of commercial fuel reprocessing



Variety of RTR fuel

UAl RTR fuel : Our customers

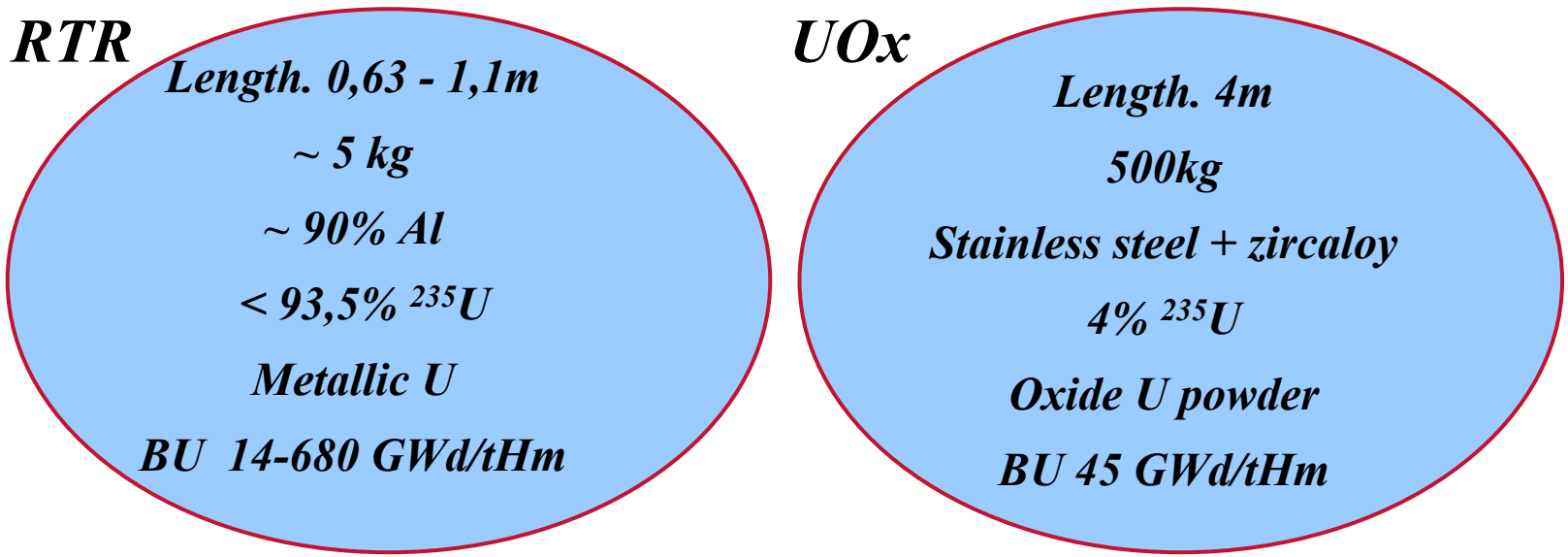
- France : CEA Grenoble, Saclay, Cadarache; Institute Laue Langevin from Grenoble (ILL); University Louis Pasteur from Strasbourg (IN2P3)
- Aboard : Belgium (SCK CEN); Australia (ANSTO)



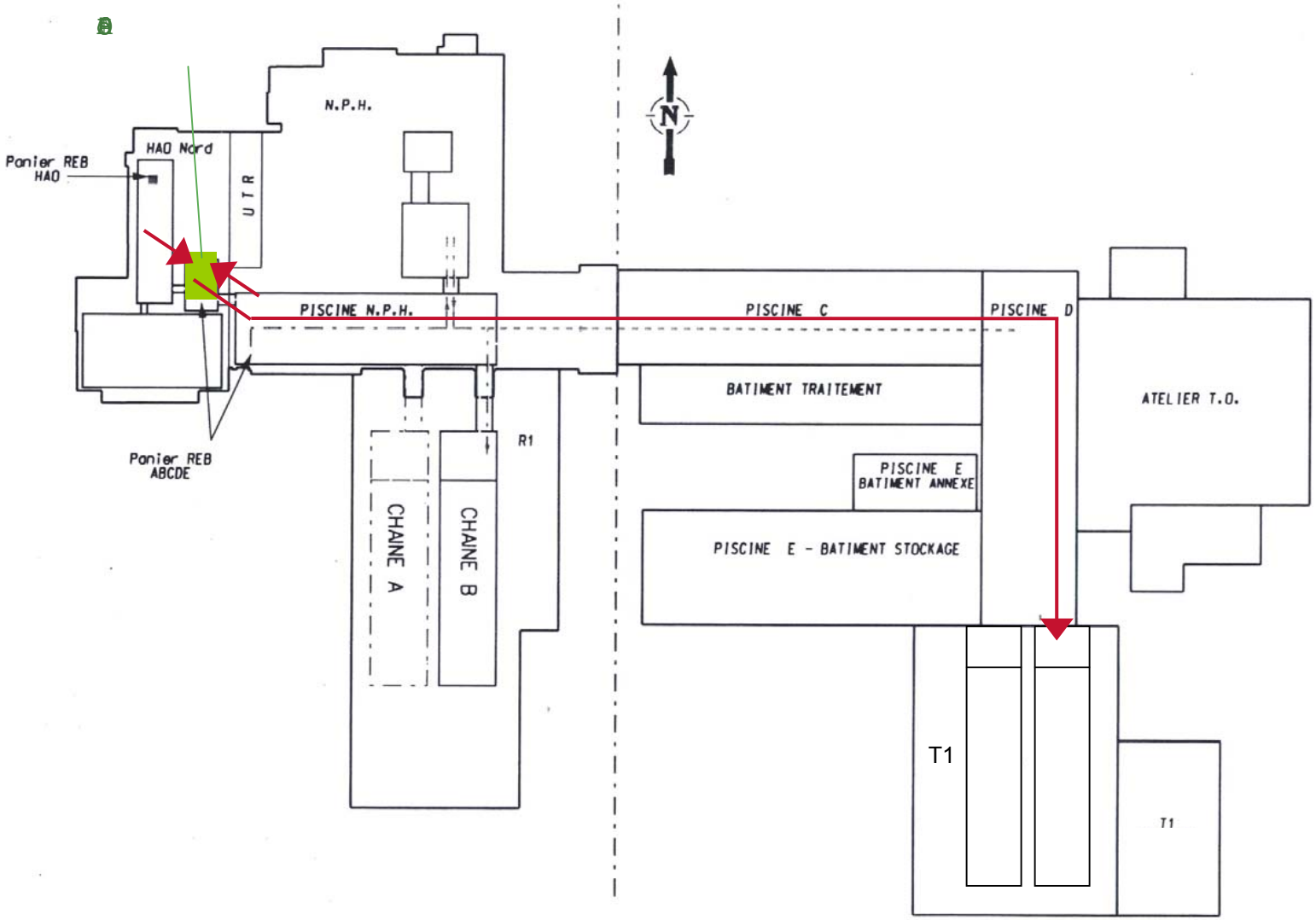
ANSTO Mark 4 BR2 MOL 10S BR2 MOL S3S Orphée Standard

Comparison of power plant fuel and RTR fuel

- **Impurities of aluminum cladding must be well known for reprocessing**



RTR process description
Transfer of RTR fuel assemblies



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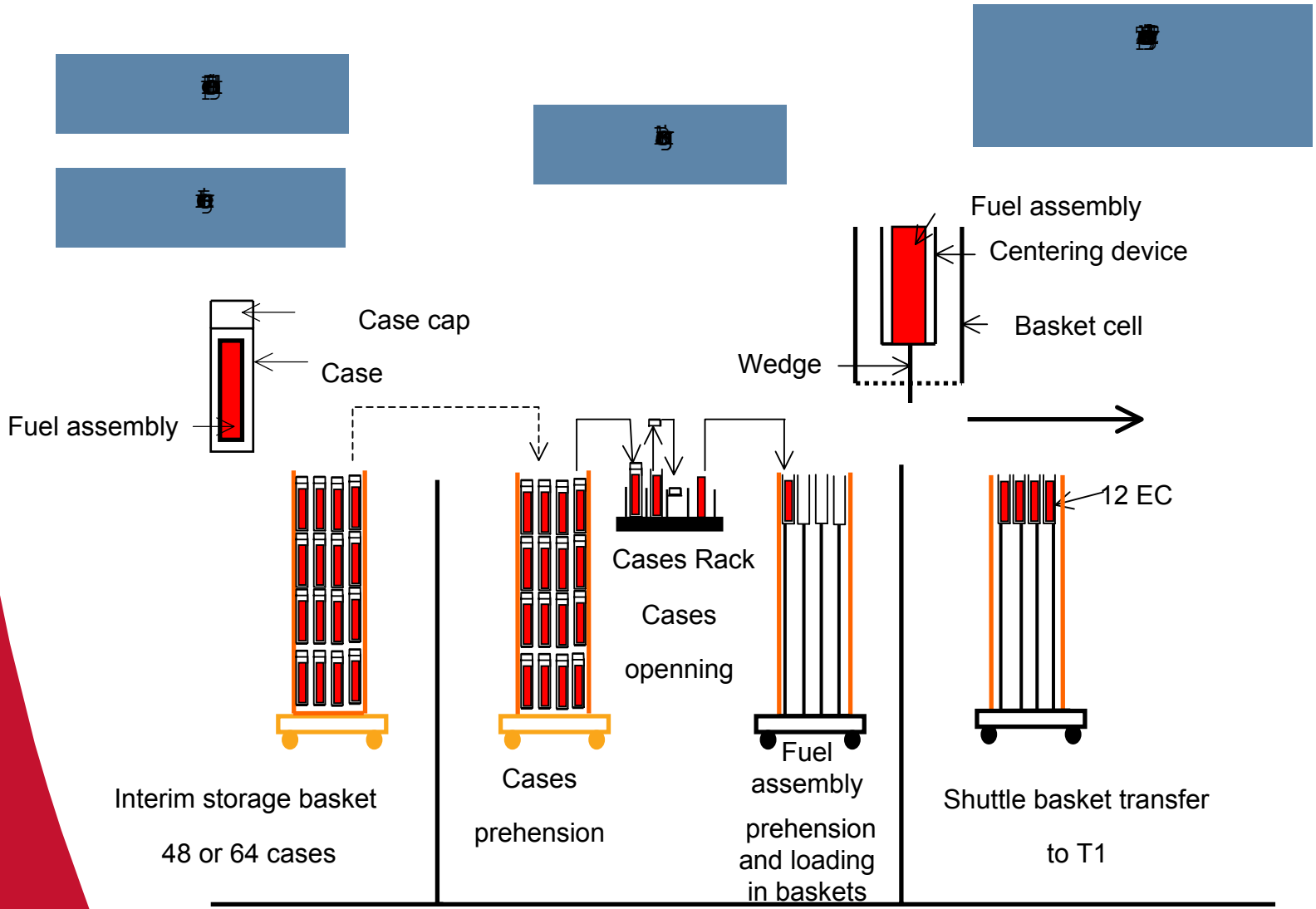
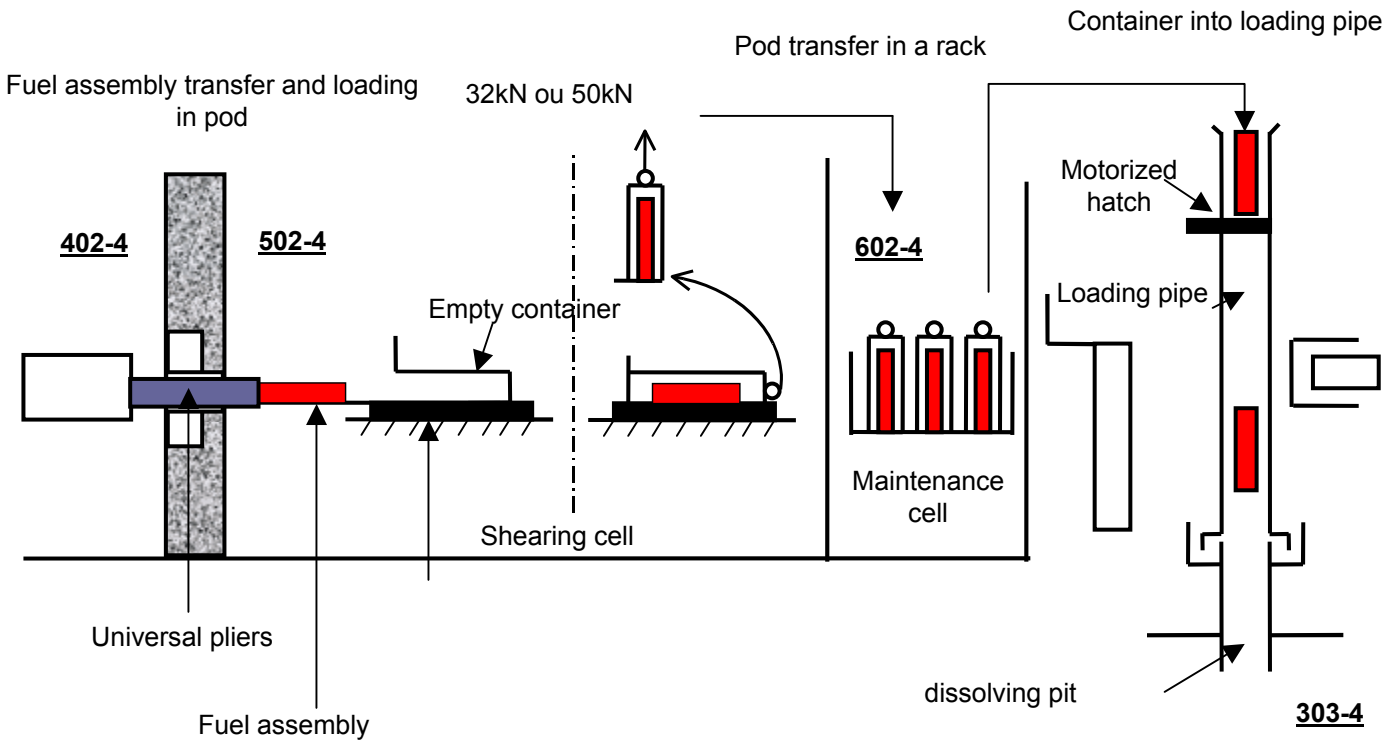


RTR process description
RTR fuel assembly loading

- **Reception of shuttle baskets**
- **FA handling via tilting crane with specific grips**



RTR process description

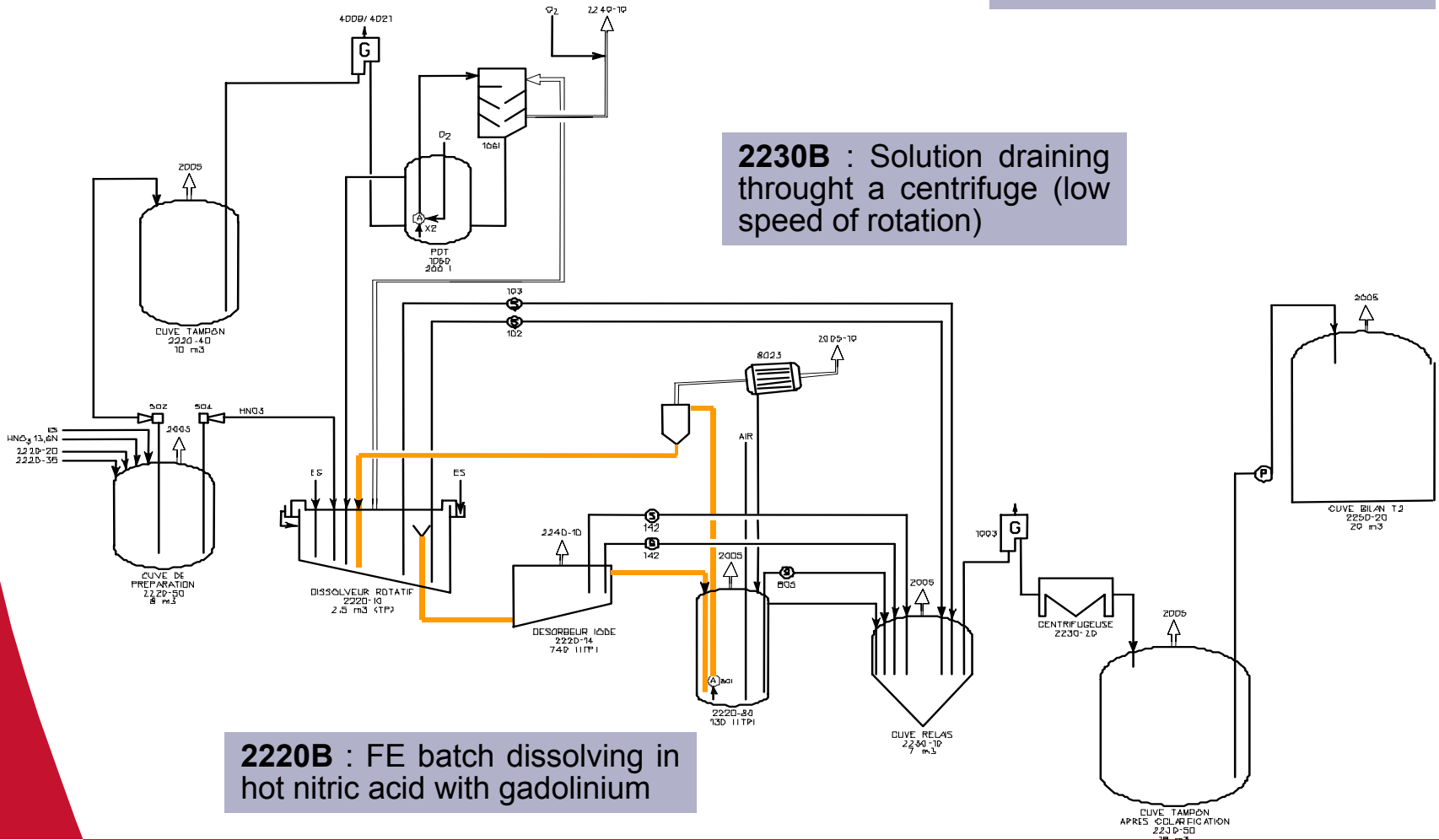
- Batch dissolving of RTR fuel assemblies in a pit specially designed for RTR fuels placed in the existing dissolver of shearing dissolving facility
- Fuel assemblies are loaded in the dissolving pit one by one. New loading is made as soon as there is no emergent FA in the dissolving pit
- Loading is over when the concentration of aluminum is just lower than the solubility limit of aluminum nitrate when cooling
- The dissolving solution is mixed with UOX dissolving solution (from another dissolving line)
- The mixture complies with the requirements of back-end operations

RTR process description
dissolving of RTR fuel assemblies

2240B : Gaz treatment

2250 : Dilution with UOX solution

2230B : Solution draining throught a centrifuge (low speed of rotation)

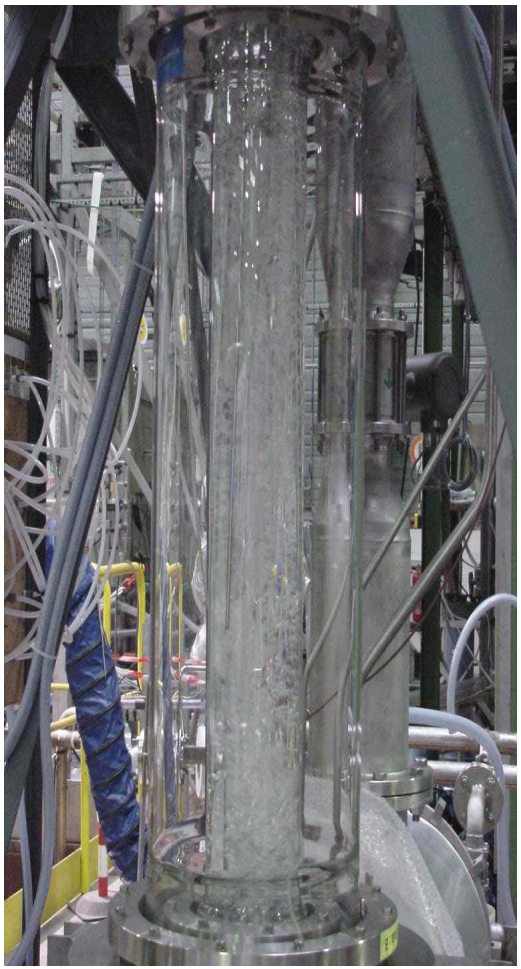


2220B : FE batch dissolving in hot nitric acid with gadolinium

RTR process description
Qualification program

- **Why a qualification program?**
  - **Innovative process and design**
    - **Mechanical area : innovative devices (universal grips, container,…)**
    - **Operating zone: limited space available**
    - **Chemical issue : avoid Al Crystallization**
    - **Safety : criticality control**
    - **Process constraints: simultaneous operating of dissolving lines**
- **Preparation phase is necessary through a qualification program in order to optimize active operations**

HRB (Beaumont Research Hall) Development testing phase



- **Dissolving of simulated fuel assemblies in a full-scale instrumented dissolving transparent pit**

HRB (Beaumont Research Hall) Qualification testing phase

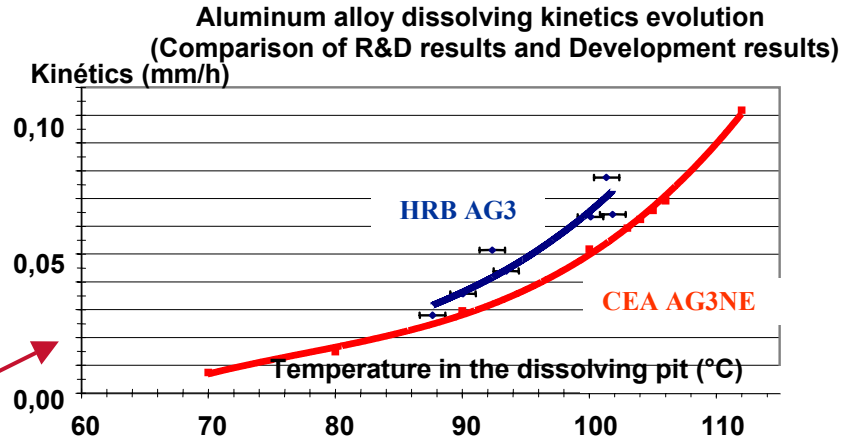
Loading pipe (full scale)

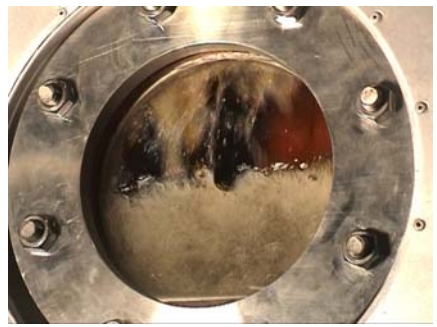
- Loading and dissolving of simulated fuel assemblies in a pilot unit

Dissolving pit (full-scale)

Results of qualification program

- **Improvement of the design**
  - Ex : development of a device to know when loading the pit
- **Collecting data about process**
  - Ex :
    - validation of dissolving kinetics,
    - Emulsion behavior,
    - way of dissolving the aluminum sheet…
- **Validation of the process efficiency**
  - Ex : avoiding dispersion out of the dissolving pit, checking homogeneity…





RTR : Project team

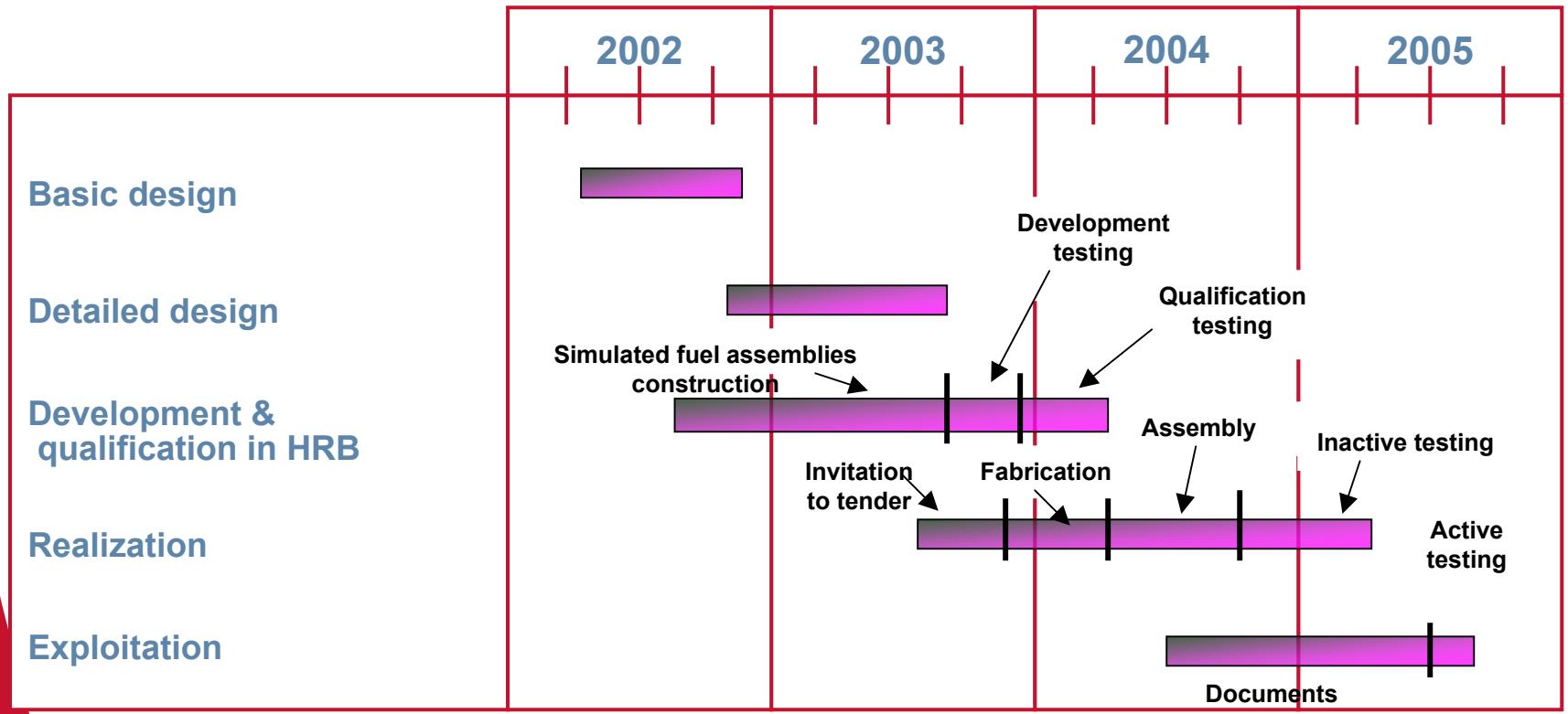
About 170 people involved in the project :

- 40 from AREVA NC

- 50 from AREVA SGN

- 80 suppliers

RTR - planning



» ***First dissolving batch completed in June 2005***

Industrial feed-back

- **In 2005:**
  - **RTR reprocessing started in June 2005 with ANSTO (Mark 4) fuel assemblies**
  - **5 batches dissolved representing 212 FA (little less than 600 kg UAl fuel)**
  - **Dissolving and other steps of RTR reprocessing are performing as expected**

RTR - prospects

- Industrial feed-back is being collected to gain knowledge about RTR reprocessing
- RTR reprocessing is currently limited to Uranium Aluminum alloy, small enough to match the pit design limits. Prospects are:
  - Larger UAl Fuel assemblies => finding a way of cutting assemblies while managing the criticality safety
  - USi fuel => management of siliceous components in the process (R&D in progress with CEA)
  - UMo fuel => R&D in progress with CEA for both fuel development and reprocessing