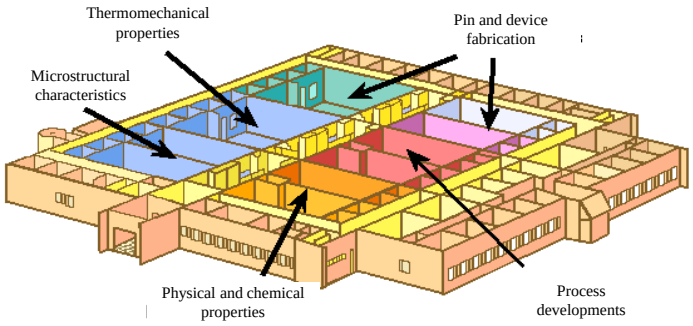
LEFCA - LBF

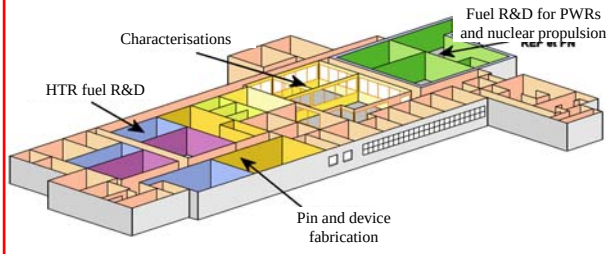
Laboratory for the study and fabrication of advanced fuels

Objectives

- Developing fuel fabrication processes to support the industry.
- Developing and characterising nuclear ceramics to support experimental fuel programmes.
- Manufacturing experimental pins or devices for nuclear fuel or material irradiation tests in research reactors.
- Conducting out-of-pile studies to support the interpretation and knowledge of in-pile fuel behaviour.



LEFCA



LBF

Characteristics of the facility

LEFCA (Laboratory for the study and fabrication of advanced fuels containing plutonium and actinide compounds)

This laboratory is a licensed nuclear facility in which plutonium, uranium, and minor actinides compounds, in any form (alloys, ceramics and composites) can be manipulated. It was commissioned in 1984 and underwent some refurbishment to reinforce its containment structure and earthquake resistance. It has twelve hot cells and houses about one hundred glove boxes. The LEFCA laboratory not only has the means to study the properties of fresh fuels and understand how they are made, but also has the equipment to fabricate fuels and objects for irradiation experiments. The tools are designed to manage various quantities, from the gram to several hundred grams.

LBF (the Bernard François Laboratory)

The Bernard François Laboratory is an environmentally regulated facility that was authorised to start operating in 1991. All uranium-based nuclear material (UOx, UMo, UF6, UCO, etc.) can be manipulated in this facility. While all enrichment levels are accepted, the total mass of 235U contained in the facility must not exceed 600 g. This laboratory has a prototype for studying processes, as well as the means for studying and understanding how fresh fuels behave and how they are elaborated.

Programmes

- Fuels for Pressurised Water Reactors (PWR)
- Fuels for Generation IV reactors
- Fuels and targets for transmutation
- Fuels for nuclear propulsion
- Assessments for the nuclear fuel industry.

CEA/DEN/CAD/DEC

LEFCA - LBF

EXPERIMENTAL EQUIPMENTS

Process design prototype

The **GAIA** (LBF) pilot facility comprises a TRISO particle fabrication unit devoted to research on HTRs:

- ✓ SOLGEL reactor,
- ✓ Chemical vapour deposition (CVD) furnace.

SOLGEL Réactor (LBF)

CVD furnace (LBF)

Fuel fabrication means

- ✓ Standard powder metallurgy equipment: crushers, mixers, presses, instrumented sintering and thermal treatment furnaces in reducing or oxidising atmospheres, grinding machines, etc…
- ✓ Machines for shaping materials by means of injection.
- ✓ The INCA line (LEFCA) reproduces all the MOX fabrication stages on a semi-industrial scale.
- ✓ The TITANS line (LEFCA) meets the requirements of programmes on nitride and carbide fuels.

INCA Line (LEFCA)

Physicochemical characterisation

Precise characterisation of materials:

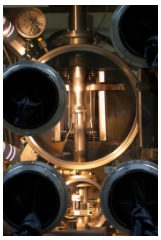
- ✓ BET, laser granulometry and mercury porosimetry,
- ✓ DTA/ DTG, dilatometry, and O/M measurements,
- ✓ Ceramography line,
- ✓ Optical microscopy, imaging analysis, SEM, field effects, microanalysis using EDS and WDS, environmental SEM, etc...

Field-effect SEM (LBF)

Measurement of material properties

- ✓ Mechanical test machines (compression and bending up to 1,770°C).
- ✓ Crystal properties by XRD and high-temperature XRD (LEFCA).
- ✓ PROTEE device (LEFCA): very high temperature drop calorimeter and diffusivimeter.

Thermomechanical characterisation (LBF)



PROTEE (LEFCA)

Assembly of irradiation devices

- ✓ Pellet cladding and TIG welding of cladding.
- ✓ Sealing and pressurisation of fuel pins.
- ✓ Assembly of irradiation devices.
- ✓ Instrumentation of devices.
- ✓ Related tests and checks: X-ray, liquid penetration test, metrology, helium concentration, etc.

Instrumented device

Glove box welding (LEFCA)