

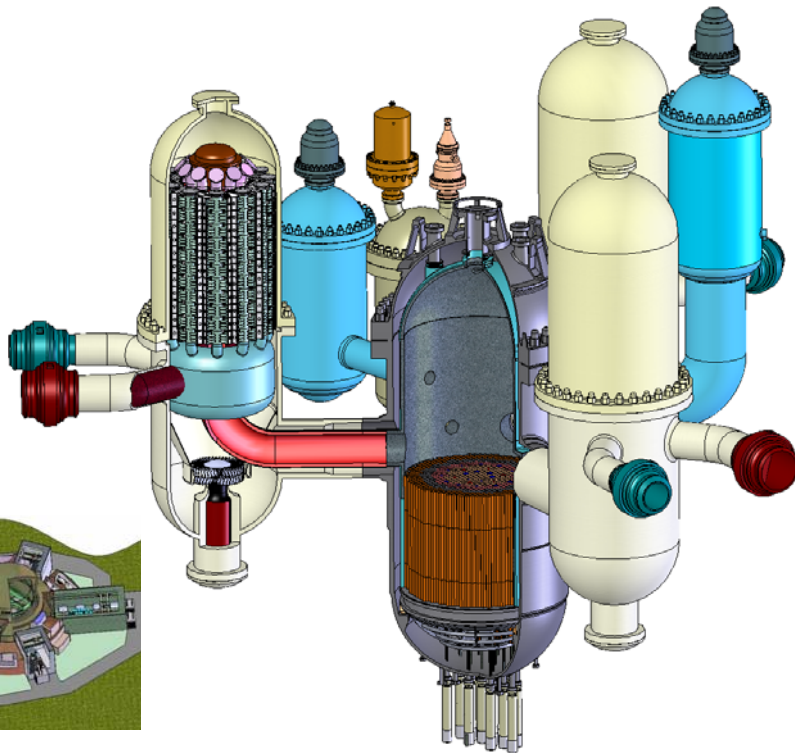


The Gas-cooled Fast Reactor (GFR)

An advanced concept combining a sustainable development with benefit from high temperature



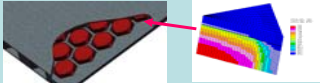
GFR 2400 MWth



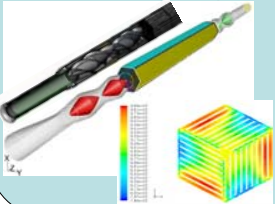
Design of the GFR core and fuel

Neutronics/thermal-hydraulics/mechanics optimization

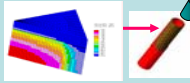
Plate-type fuel element based on reinforced ceramic structure



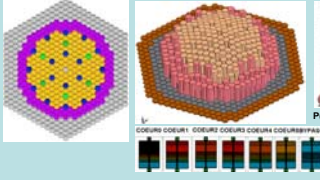
Sub-assembly design



Pin-type fuel element with composite ceramic clad



Core layout

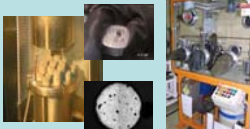


Nitride & carbide fuel fabrication

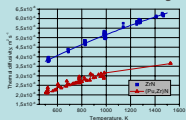
Actinide Laboratory



UPuC fabrication



Thermal diffusivity of ZrN, (Zr, Pu)N

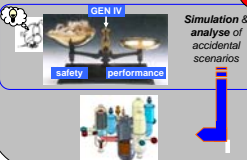


Systems & components studies

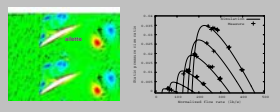
Systems design definition:
✓ For energy power conversion.
✓ For a safe decay heat removal

Axial & radial blowers

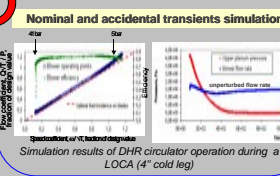
Compact heat exchangers: 25 MW/m²



Blowers preliminary designs & models: off design performances charts, multi-scales approach.



Velocities & vorticities at a marked incidence



Fuel handling device

Mechanics

Thermal-hydraulics

Accidental transient calculations

Design and integration

Safety studies

Modelling: CATHARE, TRAC,...

Transient analysis with conservative assumptions

10 inches LOCA

Study of success/failure of PSA sequences

Probabilistic Safety Assessment (PSA) as a support to the design

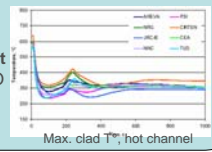
- Modelling of accidental sequences taking into account uncertainties
- Ordering versus their resulting risk of core damages

Safety feed-back on the design process

GCFR FP6 benchmark

Organization	Country	Main contribution
AMEC	UK	Coordination, Integration, Safety
NERA	UK	GFR fuel, ALLEGRO sub-assembly
CEA	France	GFR/ALLEGRO core - integration/safety
EA	Spain	Energy conversion cycles - Containment design
FRAMATOME	France	GFR integration and safety
JRC-IE	EU	GFR Safety
JRC-ITU	EU	GFR Fuel
NRG	NL	GFR safety ALLEGRO reflector
PSI	Switzerland	System code Benchmark Safety, GFR/ALLEGRO transient analysis
TUD	NL	MA burning core physics
CIRTEN	Italy	MA burning core physics

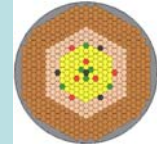
Example: Benchmark on transient Calculations: ALLEGRO Loss of Flow with scram



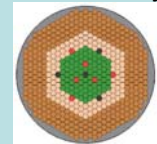
ALLEGRO An experimental prototype 80MWth

- ✓ A technology demonstration as a first gas-cooled fast reactor
- ✓ An advanced fuel qualification tool
- ✓ A global irradiation offer

ALLEGRO MOX core



ALLEGRO refractory core



- MOX
- GFR
- Réflecteur
- CSD
- DSD
- Prot. Neutroniques

