



Innovative Systems Section Activities

DE LA RECHERCHE À L'INDUSTRIE

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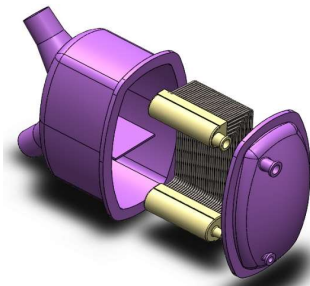
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Innovative design and development of nuclear systems



Multi-scales

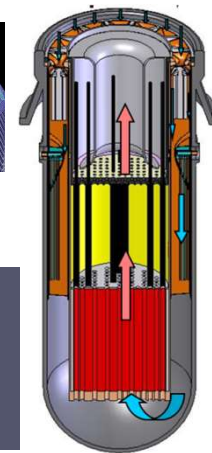
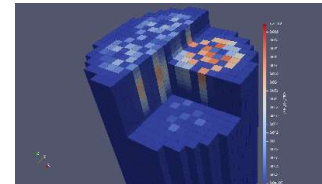
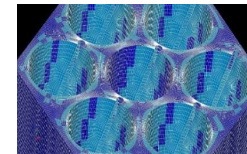
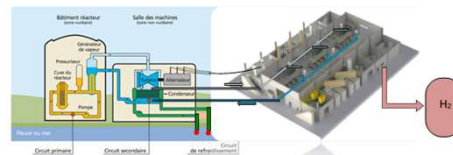
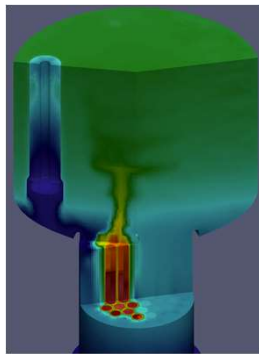
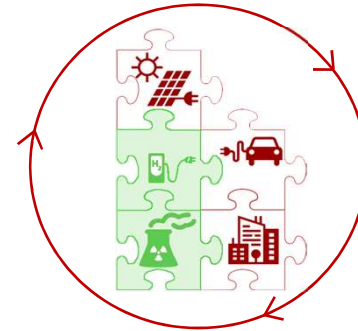
- From component to reactor

Multi physics

- Thermal hydraulic
- Neutronic
- Thermal

Multi fields

- Reactor physic
- Safety operation
- Technical economy
- Energetic System



Innovative Systems Section

- Head section + Deputy head section/Assistant
- 2 Project Leader (VTECO, IDNES)
- Industrial Architect (SPV NUWARD)
- Safety manager
- Project Manager in the Multiphysic Field

LCOS

Pre-Design and System Optimization Laboratory

pre-Design, operation/safety, Probabilistic safety study, human factor, tech-economy.

LEMS

Systems Studies and Modeling Laboratory

multiphysics, thermal-hydraulics, severe accident physics, energetics and statistics, uncertainties, VVQI

46 Permanent Engineers

4 labeled to conduct research, 8 experts

9 PhD , 2 Post-Doc, ≈ 20 internships / years

Skills :

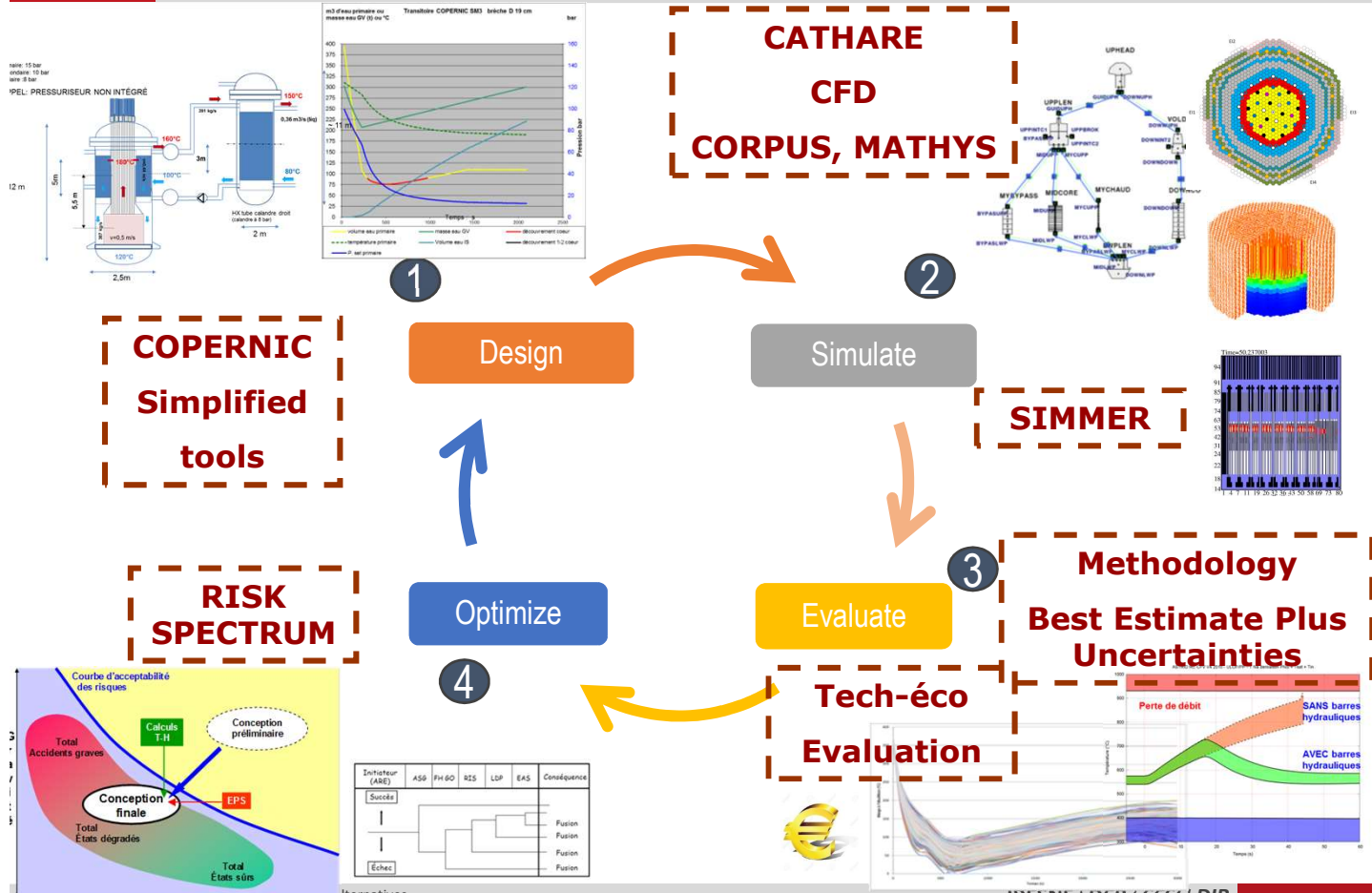
Pre-design and evaluation of innovative nuclear systems

Missions:

- propose preliminary designs of nuclear systems (reactor, safety systems (passive systems), energy conversion cycle and/or coupling to industrial processes) - Reactor survey
- produce assessments of all or part of the nuclear systems in terms of technical performance, safety including the control of severe accidents, and economy
- implement and qualify thermal-hydraulic (CFD and systems) and multiphysics calculation schemes in support of nuclear system assessments
- organize and preserve the knowledge acquired on nuclear systems in term of summaries and databases



FROM DESIGN TO OPTIMISATION



Multidisciplinary skills:

- **Reactor physics**
- **Pre-design and integrated system**
- **Thermal hydraulics** : System and CFD single phase / two phases
- **Energetic** :
 - Thermodynamic modeling and performance evaluation of energy conversion cycles
- **Safety and risk control**
 - Safety expertise applied to complex industrial installations
 - Risk Assessment Methodologies - Implementing Probabilistic Risk Assessments-Expertise
 - Human and Organizational Factor
- **Statistics and Treatment of uncertainties**
 - Probabilistic and statistical methodologies for taking into account uncertainties in numerical models
 - Statistical analysis and data sampling
- **Technico-economics**

- **Other divisions of the CEA:** Thermal hydraulics, multi-physics, mechanical, fuel, neutronic, applied mathematics
 - DM2S, DEC, DTN, DER, dismantling division
- **DAM/DPN/STXN :** HFO expertise and operation and safety
- **DRT LITEN :** Coupled SMR/ENR and heat storage
- **Industrial partners EDF and FRAMATOME**
 - Evaluation of safety architectures and passive systems
 - Uncertainty propagation methodology
 - Studies of accidental transients - multi-physics approach
- **Consortium SMR NUWARD : EDF, Naval Group et TechnicAtome**
- **Euratom : H2020 Project**
 - **ELSMOR :** SMR REP
 - **SAMOSAFER :** MSR Safety
 - **INSIDER :** Sampling with treatment of uncertainties
 - **PASTEL :** Passive system
- **Bilateral : Japan, Russia, US : GénIV System**
- **International organizations**
 - **Forum GEN4 :** Risk Safety WG
 - **GIF :** RSWG
 - **OCDE :** EGMUP, WGRISK, WGSMR



■ Missions

- Carry out the pre-design of components/systems/reactors bringing significant progress compared to the current generation of reactors, in terms of technical performance (in normal, incidental and accidental operation), safety and competitiveness (multiple context)
- sector: innovative REP, GEN-IV, SMR, naval propulsion
- Develop approaches/tools using simplified models allowing preliminary studies/pre-sizing, often parametric
- Participate in the implementation of the general safety approach
- Study the integration of nuclear power in the carbon-free energy mix*

■ Skills

- Safety, operation and multi-sector reactor architecture
- Thermal hydraulics, thermal, energy, mechanics, neutronics

■ Staff : 13 engineers (CDI + 4 CDD) + 3 PhD + trainees

■ Missions

☐ Respond to Project/Program needs through digital studies and expertise on:

- Thermohydraulics and fluid mechanics (CFD)
- Severe accident physics
- Energetic Statistics / uncertainties treatment (+ numerical methods / applied math)

☐ Mastering Scientific Computing Tools (OCS) by discipline:

- Define and apply a VVQI-T approach (Verification, Validation, Quantification of Uncertainties, Transposition)
- Integrate multi-scale and/or multi-physical chaining/coupling
- Develop and apply static/uncertainty analysis methods for studies
- Ensure the link with the code developers and the experimental
- Follow the evolution of new tools for an integrated approach to the energy system

☐ Activities in support of the design:

- Evaluate/propose energy systems (conventional, cogeneration, etc.)
- Elaborate TH calculation diagrams
- Feedback to the designer

☐ Staff : 21 engineers, 6 PhD, 1 post-doct, 1 apprentice, trainees



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