Modelling and simulation - what for?

- **Justifying installations**
  - Identification of **new safety margin** i.e. thermal shock on vessel
  - Evolution of regulations and rules
  - Analysis of accidental situations non reproducible by experiments
    - i.e, severe accidents, fire propagation, geological disposal

- **Understanding physics or system response**
  - **Ageing** of materials and installations i.e loads,
  - Addressing the issue of uncertainties and identifying the prominent parameters

- **Qualifying and optimizing processes**
  - NDT methods
  - **Optimizing** equipment i.e combustion, cooling systems
The need for a complete chain of skills and tools

1- Modelling: from physics to equations
   **Navier-Stokes**

2- Analysing and coding: from equations to algorithms and codes
   **Solvers**

3- Adaptation to computers architectures for HPC
   **Code_Saturn, massively parallel**

\[
\frac{1}{v} \frac{\partial \phi(p, \Omega, E, t)}{\partial t} = - [\vec{\Omega} \cdot \vec{V} + \Sigma(p, E)] \phi(p, \Omega, E, t) + \frac{\lambda(p, E)}{4\pi} \int dE' \nu \Sigma_f(p, E') \int d^2 \Omega' \phi(p, \Omega', E', t) + \int dE' \int d^2 \Omega' \Sigma_f(p, \Omega') \phi(p, \Omega', E', t) + Q_c(p, \Omega, E, t)
\]
The need for a complete chain of skills and tools

4- Validating and identifying:
on benchmarks and experimental campaigns, determination of physical parameters V& V requirements

5- Pre and post processing:
Meshing, visualisation, error computation and mesh adaptation
The need for a complete chain of skills and tools

6- Building of methodologies:
probabilistic approach, coupled physics, 
multiscale analysis, best estimate 
analysis, data assimilation (SALOME)

7- Qualifying:
determination of validity domains 
of methodology in real life 
applications
CFD – Code_Saturne – Main Priorities

- **Verification and Validation, Uncertainty Quantification**
  - According to Int’l and EDF rules

- **Interoperability – towards a fully packaged product**
  - Salome Platform

- **Improved physics**
  - Heat transfer

- **Anticipation**
  - Assessment of advanced CFD methods
  - Next Generation of Nuclear T/H (reactor cores, SGs, ...)

EDF
THE SALOME MODELLING ENVIRONNEMENT
The open source way for in-house developed codes and systems

**Improving the codes**:  
- By validation, bug detection,  
- Extension of validity domain or to new simulation domains

**Sharing development effort**  
- Development induced in the community  
- Open codes can be coupled with other ones in multiphysics or multi purposes platforms  
- Sharing validation effort

**Facilitating collaboration**  
- With academia (no licence, capitalisation tool, .)  
- With industrial partners (interaction with others codes,

**Facilitating dissemination acceptance of methods**

**Support to education**  
- For students and initial formation  
- Building a community of end-users

*Code_Saturne, Code_Aster, Telemac, Open-Turns, Salomé*
Open Source dissemination of softwares of EDF and Partners

- Free surface Hydraulics
- Simulation
- Heat Transfer
- CFD
- Uncertainties & probabilistic methods
- Simulation Plate-form
- Thermo-Mechanics for structures

Code_Aster
TELEMAC
SUPERHES
Code_Saturne
SALOME

2001  2003  2005  2007  2010  2011
Thanks for your attention