

OpenFOAM: solve all equations in one matrix

- Open-source Field Operation And Manipulation C++ libraries/solvers
- New solvers under development in the FAST reactors group for steady-state and dynamic analysis of nuclear reactors:
 - Neutron transport based on discrete ordinates or diffusion
 - Fluid dynamics for porous medium/CFD
 - Heat transfer in fuel rods, structures, coolant
 - Thermal mechanics of reactor structures (COFUND proposal)
 - Sodium boiling (SNF proposal + cooperation with CEA)

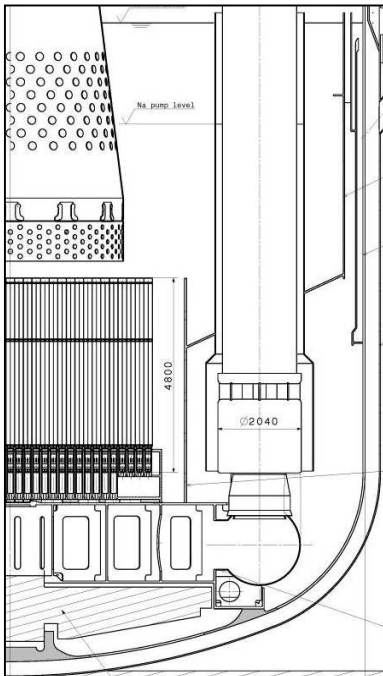
An example:

Neutron diffusion equation

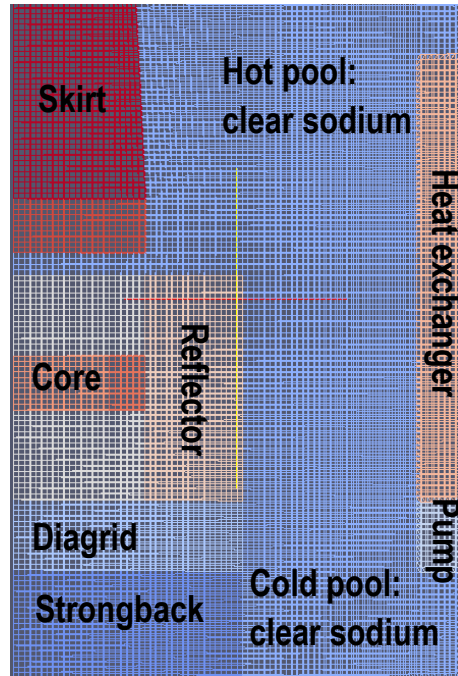
$$\frac{1}{v_i} \frac{\partial \varphi_i}{\partial t} - \Delta(D_i \varphi_i) - \sum_{i=0}^N \left((1 - \beta) \chi_{Pi} \frac{v \Sigma_{fi}}{k_{eff}} - \Sigma_{di} \right) \varphi_i - \chi_{Di} S_{Di} - S_{Si} = 0$$

as coded in OpenFOAM

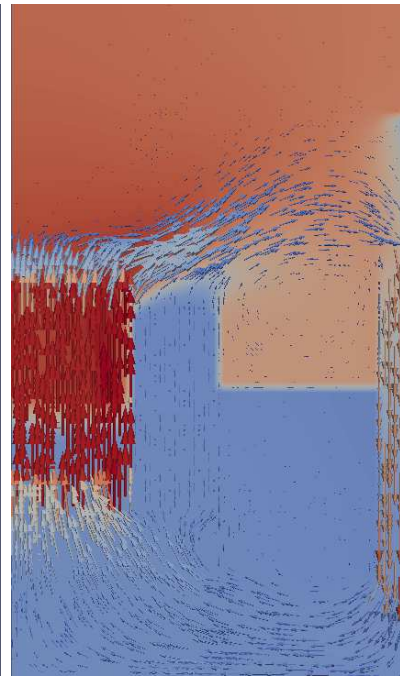
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fvm::ddt(IV, flux[energyI]) -
fvm::laplacian(D, flux[energyI]) -
fvm::Sp(nuSigmaFis[energyI]/keff*
(1.0-Beta)*chiPrompt) -
sigmaDisapp, flux[energyI]) -
delayedNeutroSource*chiDelayed -
scatteringSource
```



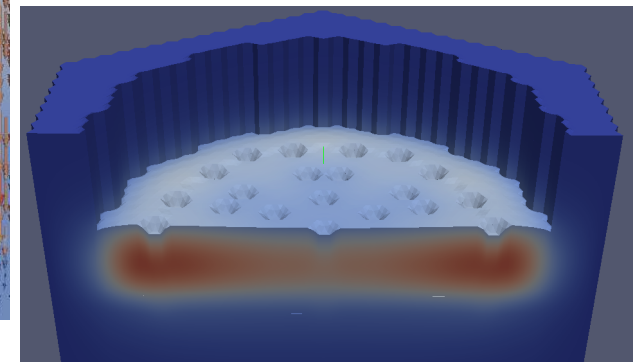
European Sodium-cooled
Fast Reactor



Combined coarse/fine mesh
for porous medium/CFD



Velocities and temperatures
in the pool



Neutron flux in the core