

## Computational Fluid Dynamics (CFD)

The powerful solution for the performance of Thermal Hydraulic (TH) and Fluid Structure Interaction (FSI) of fuel products

Optimal design, licensing, and operation with TH and FSI performance evaluation in all normal and abnormal conditions

### Challenge

Risk assessment, development of advanced Accident Tolerant Fuel and metallic fuel designs, customized designs, straightforward licensing, and efficient operation of fuel products require an accurate evaluation of the fuel product TH, (e.g. pressure drop, flow repartition, critical power, crud) and FSI (e.g. fuel assembly deformation, flow-induced vibration (FIV)) performance.

Conventional evaluation approaches – testing, system codes, subchannel codes, and engineering judgment – often do not meet budget, time, and/or technological requirements. This includes instances where flow conditions are risky to test, fuel product optimization requires evaluation of multiple design variants, defensive files must be established under time pressure, or when 3D information on pressure, velocity, void, or temperature is needed.

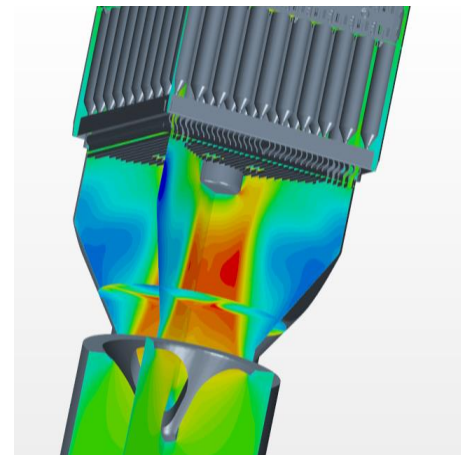
### Solution

CFD is the only tool that can predict the impact of geometry changes on TH and FSI performance.

It surpasses the limitations of conventional TH and FSI approaches, producing accurate, fast, and robust evaluations for prototypical fuel products in all normal and abnormal conditions. CFD also provides 3D information on pressure, velocity, void, and temperature.

Combining Framatome's expert nuclear knowledge with CFD allows us to offer a full range of applications to assist your needs. We can help you customize and license your fuel products, answer safety authority requests, and optimize your operation.

Obtaining proper validation is an important commitment when using CFD results. Framatome has performed validation work for pressure drop, flow field (mixing), critical power, flow induced vibrations, and fuel assembly bow.



Velocity field analysis of improved fuel TH performance

### Technical information

TH and FSI evaluations using realistic geometrical and operational flow conditions for:

- All fuel products: e.g. mixing grids, bottom and top nozzles, control rods
- All geometrical details: e.g. chamfers, dimples, welding nuggets
- All normal and abnormal conditions

Assistance in your engineering demands with:

- Crud build up, debris retention, fuel assembly and fuel rod bow, pressure drop, lift forces, flow mixing, heat removal, accidents, and flow-induced vibration
- Pressure drop, hydraulic forces, flow fields, thermal mixing, and thermal performance within measurement uncertainties

### Customer benefits

- Efficient and user-independent TH and FSI evaluation
- Reduced time-to-market for customized products
- Margin recovery through in-depth understanding of complex flow and thermal behavior from 3D information
- All-in-one toolbox for TH and FSI evaluation to customize, license, and operate fuel products

**Your performance  
is our everyday commitment**

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