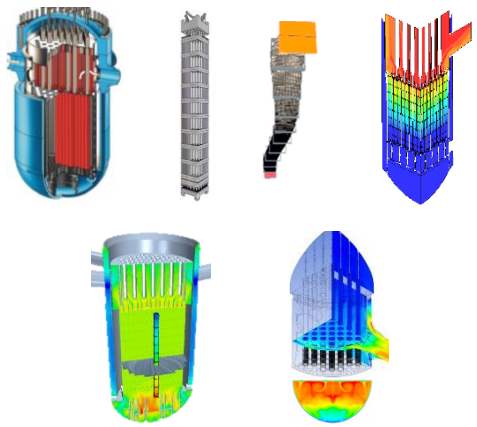
framatome

Computational Fluid Dynamics

Advanced CFD Solutions for Nuclear Fuel Performance, Reliability and Licensing Support

Expert analytical solutions and licensing support for a broad range of engineering challenges, from design optimization and custom applications to life extension programs, root-cause investigations, and first-of-a-kind implementations.



Assessment of fuel performance and system interdependencies at normal and upset conditions

Challenge

Increasingly stringent regulatory requirements and growing scrutiny of new technical solutions demand higher confidence in engineering analyses. From plant life-extension programs and operating limit changes to advanced reactor concepts and innovative fuel designs, the applicability of legacy methods and assumptions is being continuously challenged.

Solution

Framatome provides an integrated engineering services portfolio that combines advanced Computational Fluid Dynamics (CFD) analyses with deep nuclear industry expertise and regulatory support for interactions with the U.S. Nuclear Regulatory Commission (NRC) and European safety authorities.

Our validated and predictive assessments accurately evaluate the impact of design modifications, advanced fuel concepts, and innovative reactor technologies on thermal-hydraulic performance, flow-induced vibration, fluid-structure interaction, fuel assembly deformation, and debris resistance.

Performed under rigorous quality assurance standards and based on validated methodologies, our analyses deliver reliable solutions to complex turbulent flow, heat transfer, multiphase flow, and species transport challenges. By combining industry-leading simulation capabilities with decades of nuclear engineering experience, Framatome provides technical insight and regulatory confidence beyond the capabilities of conventional engineering approaches and general CFD consulting firms.

Customer benefits

Margin recovery driven by improved accuracy

- Advanced physics-based 3D methods, compliant with regulatory requirements, allow in-depth understanding of physical phenomena and coupling effects.

Faster Development and Reduced Qualification

- Built-in flexibility enables parametric design and custom modeling, resulting in reduced time-to-market.
- Optimization through cost-effective “Virtual Testing” at normal and upset operating conditions, prohibitive to physical testing.

High-confidence technical solutions

- Coupled multi-physics solutions to complex flow and system interaction problems, better design solutions, and optimal integration within legacy hardware.

Your performance
is **our** everyday **commitment**

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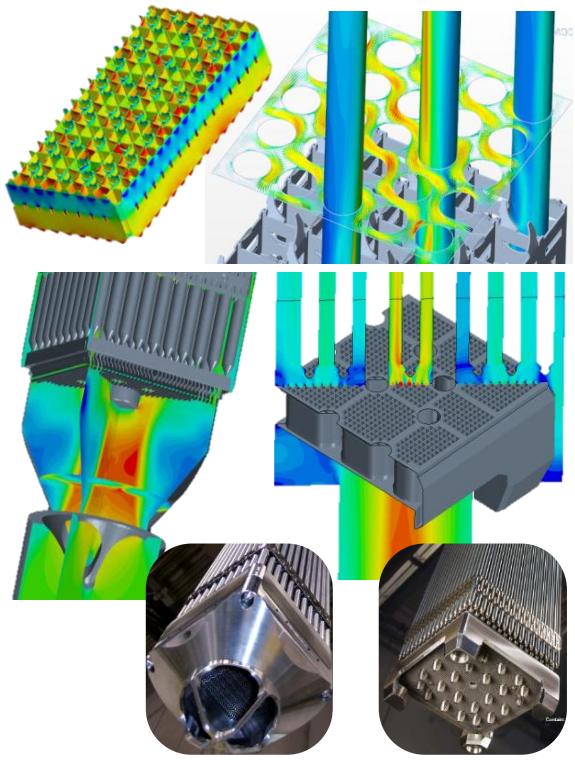
Technical Information

Framatome offers a unique combination of advanced CFD capabilities, nuclear engineering expertise, and licensing support to address complex thermal-hydraulic and fluid-structure interaction challenges. We provide:

- High-fidelity engineering assessments across all stages of product development, from conceptual design and customization to licensing and operational support
- Experimental test design, supplemental CFD virtual testing, and simulation-based remediation of field issues
- Risk-informed evaluations, root-cause analyses, uncertainty quantification, and data-driven interpretation of complex operational challenges
- Validated analyses supporting performance, reliability, operability, and regulatory compliance

Framatome has developed an integrated suite of advanced CFD tools for predicting the thermal-hydraulic performance of nuclear fuel components under steady-state, transient, and unsteady conditions. Specialized methods support critical applications including CHF, CRUD deposition, debris retention, flow-induced vibration, and fuel deformation.

All methodologies are rigorously validated against extensive proprietary and industry benchmark databases and implemented within a standardized, robust, and user-independent CFD framework. Combined with state-of-the-art high-performance computing resources, this integrated toolbox delivers reliable and timely solutions for product development, licensing, and operational support.



PWR / BWR fuel assessments based on actual 3D geometry and interactions with neighboring components

Key proficiencies

- Global Team of Experienced CFD and Nuclear Engineering Specialists
- Proven Expertise Built on More Than 20 Years of CFD Innovation and Validation
- World-class computing platform

From raw data to actionable engineering decisions through validated models and quantified uncertainty

Framatome champions the introduction of reliable predictive methods that combine high-fidelity CFD with traditional empirical elements as a mainstream analysis tool for the nuclear sector.

Our methods evolve in line with the latest CFD code advancements and the availability of high-power computing, with each methodology update being accompanied by extensive validation

ASME V&V20 methodologies are applied to quantify prediction errors, confidence intervals, and model uncertainty, ensuring that key thermal-hydraulic predictions are supported by a defensible uncertainty basis.

Framatome keeps abreast of the latest scientific advancements through successful partnerships with research institutes, national laboratories, and universities and by participating in collaborative benchmarking projects.

Detailed technical information on our CFD methods evolution, our current predictive capabilities, and validation status is available in the public domain as independent publications and as conference proceedings.

Framatome has an active and continuous presence at industry conferences such as: NURETH, TOPFUEL, ICONE, IMECE.

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