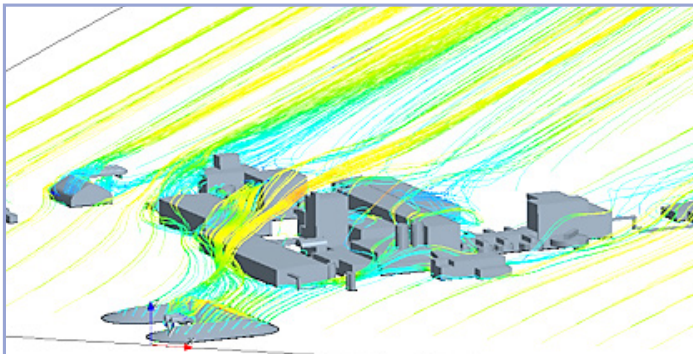
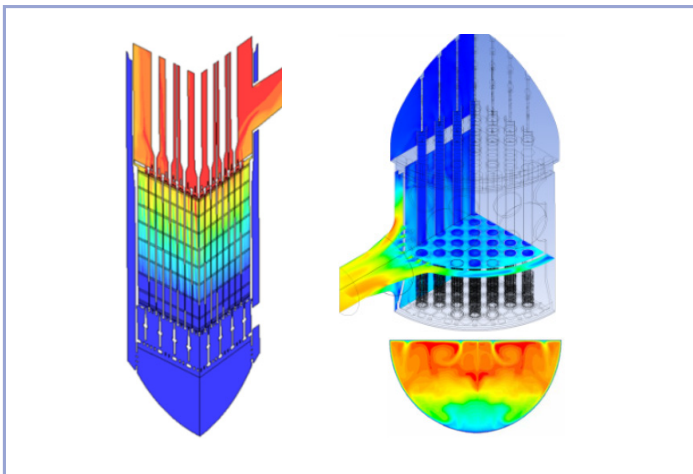


AREVA's Engineering Solutions Using Computational Fluid Dynamics (CFD)



Accident Conditions Analysis: Containment Building and Atmospheric Dispersion



Steady and Transient Analysis of Reactor Vessel, Upper and Lower Plena

Delivering solutions to a wide range of engineering problems that cannot be addressed with traditional analytical means.

The Challenge

- More stringent requirements in the Post-Fukushima environment and increased NRC and other safety authorities scrutiny of design changes, operational limits, applicability of analysis methods, engineering judgment, and assumptions
- Efficient technical decision-making in life extension, cost reduction, and field issues

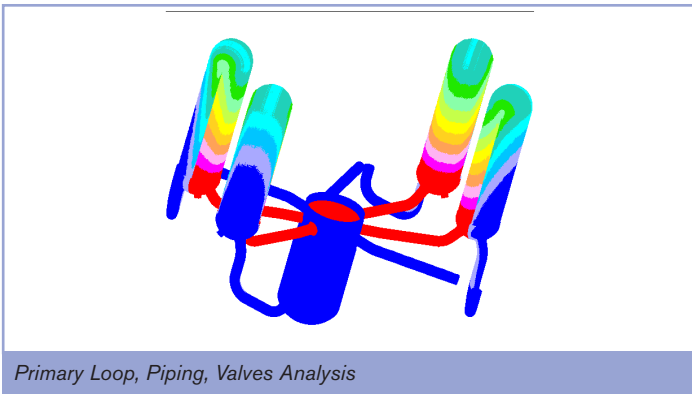
The Solution

AREVA offers high-quality CFD analyses backed by validated methods, rigorous quality assurance standards, and expert nuclear industry knowledge. We have the ability to:

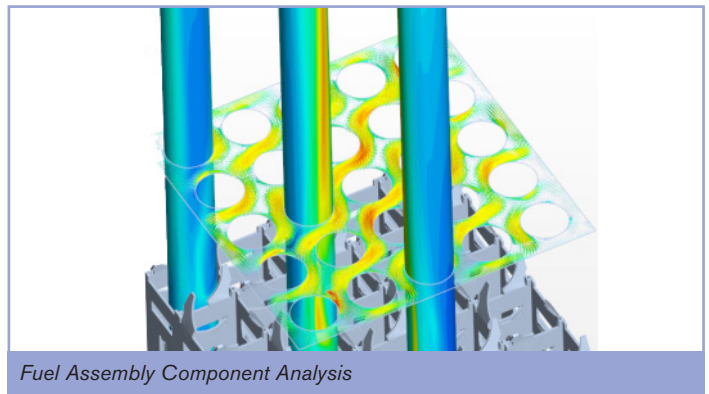
- Diagnose multi-physics problems and system interactions that are outside the capabilities of system or sub-channel codes
- Provide “virtual testing” as a low-cost alternative to physical testing at conditions prohibitive to physical testing
- Explore innovative solutions, perform design optimization, and quantify impact of design changes on system performance
- Provide solutions to first-of-a-kind (FOAK) problems to support root cause analysis
- Deliver high-accuracy solutions for:
 - Complex turbulent flow
 - Heat transfer and general thermal hydraulics
 - Multi-phase and multi-species flows
 - Fluid induced vibration, fluid structure interaction and acoustics

Benefits

- Cost reduction in optimization process
- Reduced product development time
- In-depth understanding of complex flow and thermal behavior
- Margin recovery through improved accuracy
- Verification of compliance with safety regulatory requirements



Primary Loop, Piping, Valves Analysis



Fuel Assembly Component Analysis

AREVA's CFD methodologies were validated for direct application to practical fuel, reactor and plant operation and safety problems.

Reactor Vessel Applications

- High-resolution "Virtual Reactor" analysis
- Single-phase mixing, boron dilution, lower plenum anomaly, asymmetric loop operation
- Unsteady/acoustic loads on components

Outside Reactor Vessel Applications

- Primary loop transient evaluations
- Piping system and valves: pressure waves and acoustics, temperature stratification, T-junctions thermal fatigue
- Secondary circuit components: steam generators, heat exchangers
- Containment analysis: wall condensation, hydrogen distribution, debris transport
- Pool natural convection, dry storage casks
- Environmental analysis: species atmospheric dispersion during accidents

Fuel Design Applications

- Fuel performance optimization, virtual testing, Level IV Crud assessment
- Resistance to grid-to-rod fretting and resistance to fuel assembly distortion

AREVA provides high-quality, CFD engineering services to address immediate nuclear industry needs. We utilize world-class expertise, validated methodologies, and high-power computing infrastructure.

- Cost-effective means of addressing increased scrutiny from the licensing authority and solving FOAK problems
- Best integrated package on the market combining high-fidelity CFD analyses with expert nuclear industry consulting and technical support for NRC interactions
- Analyses performed under high quality assurance standards that general-purpose CFD engineering services companies cannot provide
- Validated methods with built-in flexibility that enable timely implementation of custom modeling
- Reliable solutions to problems that cannot be accurately solved by system, sub-channel, or special-purpose codes, or would require cost-prohibitive testing

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