

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



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

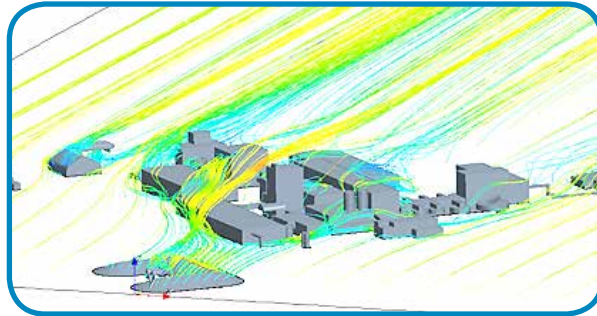
The Challenge

- 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

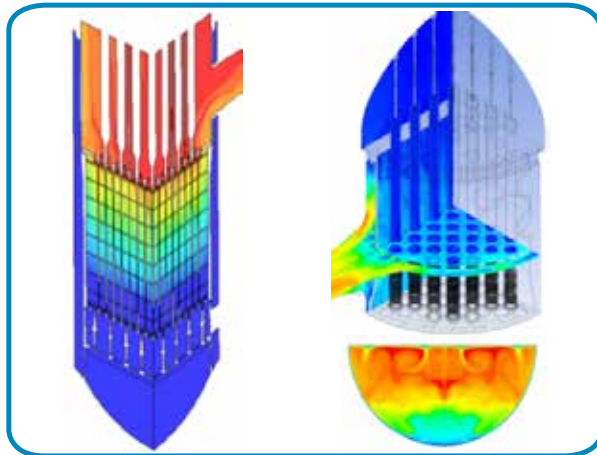
The Solution

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 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



Accident Conditions Analysis: Containment Building and Atmospheric Dispersion



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

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

AREVA's CFD methodologies were validated for direct application to practical Fuel, Reactor and Plant Operation and Safety problems.

Reactor Vessel Applications

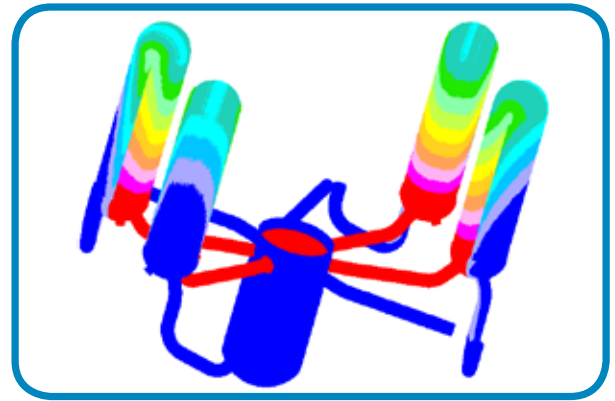
- High-resolution "Virtual Reactor" analysis
- Single-phase mixing, boron dilution, lower plenum anomaly, asymmetric loop operation
- Unsteady/acoustic loads on components

Outside Reactor Vessel Applications

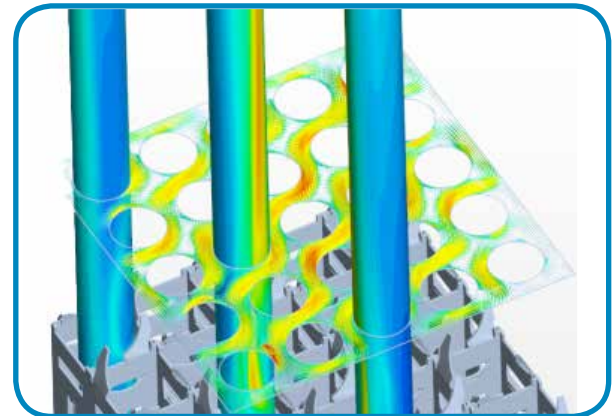
- Primary loop transient evaluations
- Piping system and valves: pressure waves and acoustics, temperature stratification, T-junctions thermal fatigue
- Secondary circuit components: steam generators, heat exchangers
- Containment analysis: wall condensation, hydrogen distribution, debris transport
- 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



Primary Loop, Piping, Valves Analysis



Fuel Assembly Component Analysis

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 first-of-a-kind (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

AREVA Inc.

For more information, contact:

AREVA Engineering Control Center

Tel: 434.832.3722

Email: EngineeringControlCenter@areva.com

or fuelsalesna@areva.com

us.aveva.com/engineering

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