framatome

Thermal-hydraulic Analyses for Pressurized Water Reactors with COBRA-FLX™

Licensing support and margin gain through detailed simulation of core and fuel assembly thermal-hydraulics

Background

Safe and economic operation of nuclear power plants is highly dependent on the accuracy and flexibility of the applied codes and methods. These codes need to be very performant to realize 3D steady-state and transient full core analyses in reasonable computing time, like COBRA-FLX™ does.

COBRA-FLX is the global thermal-hydraulic analysis and design code of Framatome. As such, it is the thermal-hydraulic module of the core simulator ARTEMIS™ within the ARCADIA® code system.

Technology for your needs

COBRA-FLX determines in detail the thermal-hydraulic behavior of fuel assemblies in the core of pressurized water reactors (PWR). Thus, operational and safety-related analyses can be performed with high accuracy for homogeneous and mixed cores. Coupling to other core simulators than ARTEMIS™ is possible, as well as including other fuel rod modules or chemical codes.

Among others, the following applications are available:

- Reload analyses for a variety of fuel assembly designs; for that numerous critical heat flux (CHF) correlations are implemented
- Lift force calculation for steady-state conditions
- Crud risk assessment
- Steaming rate prediction

A user-friendly environment facilitates the application of COBRA-FLX for various power plant and fuel assembly designs.

High-performance computing

Users can perform pin-by-pin full core transient calculations in only a few minutes. The significant acceleration of evaluations is achieved by the improved code structure and linear solvers. The parallelization of the code allows using the capacity of multi-processor computers.

Features

COBRA-FLX evaluation capabilities

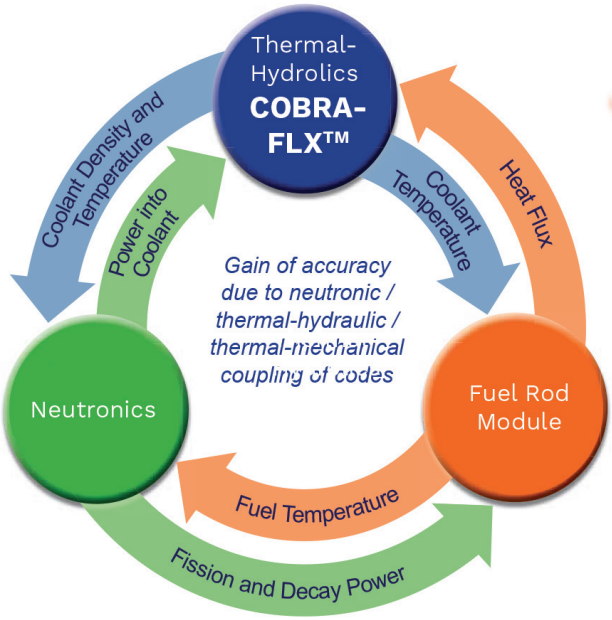
- 3D distributions of coolant flow and temperature in the core
- Steady-state and transient subchannel analysis of fuel assemblies and reactor core
- Low and even reverse flow modelling capability

Subchannel-by-subchannel DNB analyses

- Integration in the Framatome Core Simulator ARTEMIS™
- Full core pin and sub-channel wise steady-state and transient neutronic and thermal-hydraulic evaluations
- Fuel and cladding temperature distributions based on ARTEMIS™ fuel rod module

Well-defined interface routines

- Easy coupling to other codes



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

Enhanced pre-processing with graphical user environment

The Framatome versatile pre-processor CoreGen allows the comfortable input for a wide variety of fuel assembly and core designs as the geometry specification is very flexible. Internal variable scaling permits simulations from subchannels and pin-by-pin to lumped channels covering entire fuel assemblies. Axial resolution can be freely chosen over a wide range.

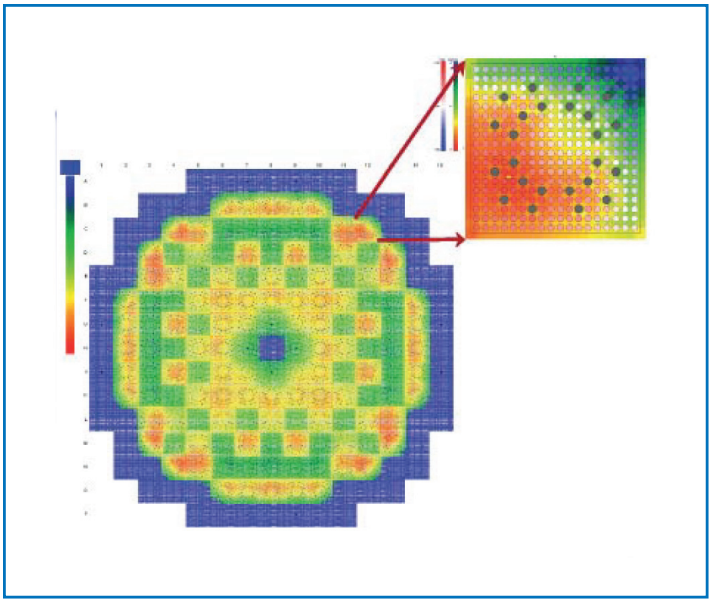
Verification and validation

Framatome disposes of a comprehensive database of measurements performed in several thermalhydraulic test loops, e.g., KATHY (Germany) and OMEGA (France). Separate effect tests were performed measuring void fraction, crossflow, temperature distribution and critical heat flux for a variety of operating conditions. COBRA-FLX is validated for steady-state and transient calculations in a wide range of parameters:

- Pressure: 1–166 bar
- Mass velocity: 120–6780 kg/m^{2}s
- Void fraction: 0–100%

Reference

- COBRA-FLX is used for business support to customers in USA, France, Germany and other countries.
- U.S. NRC Approval received in January 2013, see Topical Report ANP-10311NP-A.



Visualization of a COBRA-FLX calculation of a full reactor core with pin-by-pin resolution

Your benefits at a glance

- Gain of margins through
  - Coupled neutronic/thermal-hydraulic/thermal-mechanical methods
  - Fast pin-by-pin full core transient calculations
- Licensing support for PWR core and fuel assembly design and accident analyses
- Reload analyses for a variety of fuel assembly designs
- Improved crud risk assessment
- User-friendly and flexible core generation tool
- Easy coupling to other codes due to defined interface routines
- Worldwide accepted for nuclear reactor licensing (U.S. NRC approval since 2013)

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