Argonne NATIONAL LABORATORY

ADVANCED REACTOR DESIGN AND SAFETY ANALYSIS

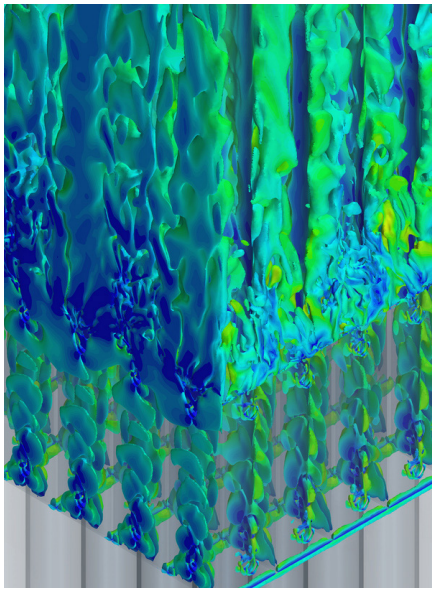
Next-Gen Reactor Systems Via Next-Gen Computation

OVERVIEW

Argonne National Laboratory maintains distinctive capabilities to develop and design advanced nuclear energy systems via its application and integration of the relevant expertise in reactor physics, thermal hydraulics, structural mechanics and materials behavior for reactor design, fuel cycle analysis, and modeling of reactor plant safety behavior. This expertise is applicable to the development, design, and safety analysis of reactors operating within a variety of neutron energy spectra, coolant types, and fuel-cycle schemes. In particular, Argonne is recognized for its capabilities and contributions to the development of fast-neutron reactors and associated fuel cycle technologies and has maintained an international leadership capability for fast reactor and fuel cycle development.

MODELING AND SIMULATION EXPERTISE

Argonne researchers carry out reactor design and safety analyses using large-scale, integrated computer codes aimed at modeling the behavior of the entire reactor and associated engineering systems. The overall reactor system model represents the relevant phenomena in system components including reactor physics, heat transfer, fluid dynamics, and reactor structural mechanics with unparalleled fidelity. These phenomenological models are used to simulate both the steady state and transient behaviors of all the major components in a nuclear power plant, including the reactor core, the coolant systems and components (vessels, pipes, valves, pumps, and heat exchangers), and the plant control and protection systems.



Visualization of fluid flow and heat transfer in a nuclear fuel pin bundle.

These enhanced modeling capabilities are continually improved and adapted as needed to represent novel design features or demonstrate enhanced performance and safety. The resulting simulation data support new design development, safety confirmation, risk assessments, and applications to the Nuclear Regulatory Commission for construction and operation licenses for existing plants and novel reactor designs.

UNPRECEDENTED COMPUTING POWER

To advance and test nuclear reactor modeling and simulation tools Argonne researchers and collaborators employ the laboratory's Leadership Computing Facility (ALCF).

The ALCF's mission is to accelerate major science and engineering breakthroughs by providing world-leading computing capabilities in partnership with the computational science community. ALCF supercomputing resources and expertise are applied to assist researchers in solving some of the world's largest and most complex problems in diverse disciplines ranging from chemistry and biology to physics and materials science.

The ALCF is home to MIRA, an IBM Blue Gene/Q that drives scientific discoveries and engineering breakthroughs via a top speed of 10 quadrillion calculations per second (placing it among the most powerful computers in the world). More than 5 billion computing hours are allocated on Mira each year.

CONTACT

Robert N. Hill
Technical Director,
Senior Nuclear Engineer
Nuclear Engineering Division
Phone: 630-252-4865
E-mail: bobhill@anl.gov