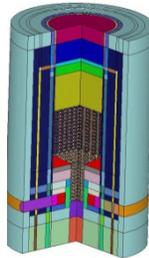


Reactor Physics

- Develops reactor and fuel cycle analysis software for SCALE and the Consortium for Advanced Simulation of Light Water Reactors (CASL)
 - TRITON core and lattice physics methods
 - ORIGEN isotopic transmutation, depletion, and decay
 - Sensitivity/uncertainty methods for reactor analysis
- Analyzes advanced concept and research reactors
 - CASL light water reactors
 - High Flux Isotope Reactor (HFIR) at ORNL
 - High-temperature reactors (gas cooled or fluoride salt cooled)



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Nuclear Security Modeling

Utilizes expertise in theory, modeling, and experimentation to analyze the security implications in the production, processing, diversion, and detonation of nuclear materials

Areas of Expertise

- Reactor modeling and simulation
- Nuclear chemical engineering
- Nuclear safeguards and nuclear detection
- Nuclear forensics and attribution
- Nuclear weapons physics and fallout

Selected Applications

- Plutonium production in reactors
- Spent nuclear fuel assay and verification
- Passive nuclear measurements modeling
- Active interrogation systems modeling
- Nuclear fallout modeling and analysis
- Reactor physics measurements



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R&D Focus Areas

Small Modular Reactor Technology R&D

- The DOE R&D activities for advanced small modular reactors began in FY12. R&D areas at ORNL include sensors, instrumentation, reactor controls, modeling and simulation, materials, fabrication technologies, and fuels. Development of advanced SMR concepts is also included in the program scope.



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NRC Projects Office

- RNSD is responsible for managing and coordinating the R&D activities performed at ORNL via interagency agreements between the Nuclear Regulatory Commission (NRC) and DOE.
- Work for NRC focuses on reactor and fuel cycle analysis, instrumentation and controls, licensing and infrastructure support, materials and structural integrity, and operational assessments.

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Advanced Nuclear Modeling and Simulation

RNSD is leading the development of advanced computational tools that support R&D and safety analysis for reactor and nonreactor nuclear applications. The SCALE code system developed and maintained by RNSD is used internationally to support reactor physics, radiation transport, criticality safety, and reactor depletion/source term prediction. Through the DOE Energy Hub, the Consortium for Advanced Simulation of Light Water Reactors (CASL), RNSD is supporting advanced modeling and simulation of reactors on high performance computers. Expertise in the application of these and other state-of-the-art tools is a key focus area.

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Nuclear power provides a significant clean energy source for our nation and the world. The Reactor and Nuclear Systems Division (RNSD) of the Nuclear Science and Engineering Directorate at Oak Ridge National Laboratory provides the science and technology to address issues facing current and future utilization of nuclear reactors and supporting nuclear systems infrastructure.

Research Groups

- Nuclear Data & Criticality Safety
- Nuclear Computational Information
- Thermal Hydraulics & Irradiation Engineering
- Advanced Reactor Systems & Safety
- Radiation Transport
- Design, Safety & Simulation Integration
- Reactor Physics
- Nuclear Security Modeling

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Nuclear Data & Criticality Safety

- Conducts basic science and applied R&D to support nuclear technology applications with emphasis on nuclear criticality safety. A key characteristic is the coupling of nuclear data expertise with methods/software development and applications expertise.
- Utilizes computational nuclear methods and analysis expertise and practical applications experience to provide problem-solving tools, technical solutions, and policy advice to customers within DOE, the Nuclear Regulatory Commission, and other government and private organizations.
- Responsible for the development, enhancement, and maintenance of several key codes and capabilities in the SCALE code system, principally those associated with criticality safety analyses and nuclear data, as well as SCALE V&V and computational architecture development.
- Performs cross-section measurements and analyses to develop nuclear data evaluations for the ENDF/B system.
- Develops software and methods to support the evaluation of measured cross-section data (SAMMY) and the generation of cross-section libraries (AMPX) for radiation transport.

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Radiation Safety Information Computational Center

- Collects, tests, and distributes nuclear software, corresponding processed nuclear data, and experimental and computational benchmarks
- Promotes international collaboration through software exchanges with the Organization for Economic Cooperation and Development (OECD) Nuclear Energy Agency Data Bank (NEADB)

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Thermal Hydraulics & Irradiation Engineering

Thermal, Fluid, & Irradiation Experimentation

- Design assembly and operation of material and fuel irradiation experiments for the High Flux Isotope Reactor (HFIR)
- Heat transfer measurements
- Fluid flow characterization
- Two-phase flow experimentation

Heat Transfer, Fluid Flow, & Reactor Safety Analysis

- Reactor thermal hydraulics
- Nuclear fuel behavior
- Severe accident analysis
- Computational fluid dynamics
- Explosion and aerosol transport analysis
- Thermal hydraulic code benchmarking and support for experimental design

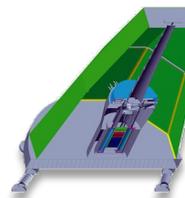
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Advanced Reactor Systems & Safety

- Supports the design, operation, control, and safety of nuclear systems, focusing on the development of next-generation reactors for terrestrial and space power applications
- Identifies technologies requiring further R&D to evolve these advanced concepts
- Supports DOE's Generation IV (Gen IV) initiative and the Nuclear Regulatory Commission's activities in licensing new plants and the evaluation of operations and license amendments for the existing fleet of commercial nuclear power plants
- Conducts both analysis and modeling of reactor power systems combined with technology development and validation of such systems through unique experimental facilities

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Radiation Transport

- Develops deterministic and Monte Carlo methods for the Consortium for Advanced Simulation of Light Water Reactors (CASL) and SCALE software projects
- Applies expertise in radiation transport to address reactor and nonreactor shielding and activation problems
- Develops and applies leading-edge computational software to enable solutions to large and complex nuclear energy and national security applications on the world's fastest supercomputer in the areas of radiation transport, shielding, reactor physics, fusion, and sensitivity and uncertainty

Capabilities/Products (Part of SCALE Software System)

- Denovo—massively parallel deterministic radiation transport capability enabling solutions to very large and complex nuclear energy and security applications
- ADVANTG/MAVRIC—hybrid radiation transport capability making impossible/impractical Monte Carlo simulations possible/practical
- Shift—the next generation in Monte Carlo capability for solving “real-world” reactor and shielding transport problems

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Design, Safety & Simulation Integration

- Integrates nuclear design, safety, and modeling and simulation activities that span multiple organizations to provide solutions to complex and challenging nuclear issues of national importance
- Substantial expertise in nuclear design, systems and safety analyses; reactor physics/technologies; storage, transport, and disposal of used nuclear fuel; nuclear regulatory issues; and computational modeling and simulation methods and software development
- Leadership for SCALE code system

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