Enabling a Sustainable Nuclear Energy Future

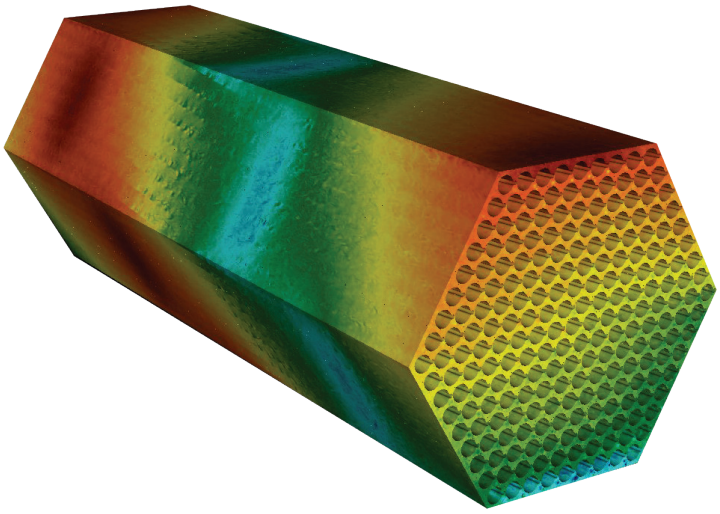
Today, nuclear energy is the largest non-carbon electricity production method in use, but the nation must effectively address economic and waste management concerns to enable its sustained use and continued growth. Argonne National Laboratory is deeply engaged in research that will ultimately allow a U.S. expansion of nuclear energy systems that are cost-effective, safe, and secure. The Laboratory's goal is to advance the use of nuclear energy by incorporating scientific and engineering breakthroughs in the design and operation of advanced nuclear energy systems.

Advanced Nuclear Energy Systems

Argonne hosts a team of leading scientists and engineers that are at the forefront of scientific research on advanced nuclear energy systems. Their expertise in reactor physics and engineering, separations science, materials science, and actinide chemistry optimally position them to integrate innovations and discoveries in the design and operation of future nuclear systems. Argonne nuclear energy researchers also have access to the Advanced Photon Source, Center for Nanoscale Materials, Electron Microscopy Center, and the Argonne Leadership Computing Facility – major scientific research facilities that can significantly enhance discovery and provide an improved understanding of relevant phenomena.

Advanced Modeling and Simulation

Argonne computational scientists and engineers have created and refined a sophisticated set of integrated models and advanced simulation tools that demonstrate and validate new nuclear energy technologies. These tools also help improve the design and safety of advanced reactors. The use of advanced simulation has the potential to greatly reduce the cost of nuclear reactor facilities by allowing scientists to better identify and target the physical experiments that underlie their design and optimize the design and licensing process. With Argonne's Advanced Leadership Computing Facility and world-class expertise in nuclear engineering, computing, and nuclear computational science, the Laboratory is uniquely positioned to continue its development and validation of modeling and simulation capabilities for future generations of nuclear reactors.



Pressure distribution for turbulent coolant flow in a 217-pin nuclear reactor subassembly. The simulation was performed by the Argonne SHARP (Simulation-based High-efficiency Advanced Reactor Prototyping) group using 32,000 processors of the Blue Gene/P at the Argonne Leadership Computing Facility. Computer time was provided through the DOE INCITE program.

Physical Chemist Carol Mertz (left) and Analytical Chemist Mike Kalensky use the mini-Gas Pressurized Extraction Chromatography (GPEC) system to age date radioactive source materials. Argonne has developed and validated age-dating methods and guidance documents for the entire nuclear forensics community using the GPEC system and other separation and analysis technologies.

Advanced Separations Technologies

Argonne chemists and engineers have developed processes to reduce nuclear waste volumes and recover valuable elements from spent nuclear fuel. These techniques allow portions of the spent fuel to be reused. Separations technologies based on pyrochemical and aqueous approaches are being developed for existing spent nuclear fuel and specialized transmutation fuels. The major objectives are to reach sufficient throughputs at acceptable cost and low loss rates to the waste streams.

Nuclear Waste Management

Argonne's extensive capabilities in risk assessment, simulation, materials science and engineering, and source term science can be applied to a broad range of needs for the geologic repository system, from transportation and storage of radioactive waste to its permanent disposal.

Nuclear Nonproliferation

Argonne has a distinguished history of advancing the nation's nonproliferation goals. Since 1978 the Laboratory has led the effort to convert research and test reactors worldwide from high-enriched uranium fuel to low-enriched uranium. We also lead the development of secure technologies for recycle of spent reactor fuels and the incorporation of effective safeguards in the design of future nuclear energy systems.

Materials Development

Future nuclear power plants are likely to operate at higher temperatures and have unique corrosion environments, so advanced structural materials will be necessary. Argonne has world-class expertise in experimental and modeling approaches to further fundamental understanding of materials durability in high-temperature and high-radiation environments.

Environmental Assessment

Argonne conducted the first nuclear power plant environmental impact analyses in the nation, and we are recognized as the preeminent national laboratory for this activity.

CONTACT ▸ Pam Sydelko | 630.252.6727 | psydelko@anl.gov | www.anl.gov