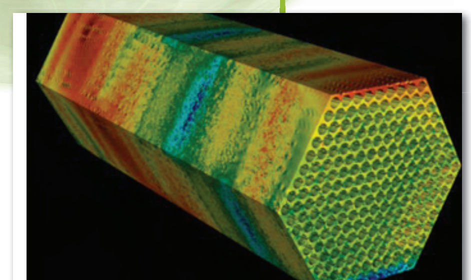
Advanced Reactor Concepts

The U.S. Department of Energy's Office of Nuclear Energy

Advanced reactor concepts will provide substantially enhanced operational performance, safety, security, economics, and proliferation resistance over currently deployed light water reactor technologies. These enhancements will be realized through national and international research and development collaborations.

The Advanced Reactor Concepts (ARC) program, an expanded version of the Generation IV research, development and demonstration (RD&D) program, sponsors research, development and deployment activities leading to further safety, technical, economical, and environmental advancements of innovative nuclear energy technologies. The Office of Nuclear Energy (NE) will pursue these advancements through RD&D activities at the Department of Energy (DOE) national laboratories and U.S. universities, as well as through collaboration with nuclear industry and international partners. These activities will focus on advancing scientific understanding of these technologies, establishing an international network of user facilities for nuclear RD&D, improving economic competitiveness, and reducing the technical and regulatory uncertainties for deploying new nuclear reactor technologies.



BENEFITS OF R&D FOR ADVANCED REACTORS

As a result of ARC research, nuclear energy will continue to provide clean, affordable, and secure energy while supporting the administration's greenhouse gas reduction goals by introducing advanced designs into new energy and industrial markets. DOE will pursue RD&D on both advanced thermal and fast neutron spectrum systems.

High-temperature reactors provide higher reactor outlet temperatures. When coupled with advanced energy conversion systems (e.g., S-CO_2 Brayton cycle), high-temperature reactors will provide significantly improved thermal efficiency for power generation and a range of industrial applications.

Fast neutron spectrum systems could be used to consume long-lived, high-activity elements found in used light-water-reactor fuels, thus providing used fuel management alternatives to direct geological disposal by "burning" undesirable constituents of used fuel. Many potential fuel cycle options are enabled by using fast neutron spectrum systems. Higher outlet temperatures allowed by the liquid-metal coolants, coupled with supercritical CO_2 Brayton cycle energy conversion, will also increase thermal efficiency.

Program Budget

Advanced Reactor Concepts ($ in Millions)	FY 2012 Request
	$21.9

INTERNATIONAL COOPERATION

Key to achieving these advancements is the multiplication effect on investment from international collaboration. By coordinating U.S. efforts with partner nations, our funding is leveraged by the integration of decades of diverse nuclear energy experience and expertise. The United States collaborates with the international community through the Generation IV International Forum (GIF), the International Atomic Energy Agency (IAEA), and through bilateral and multilateral agreements.

PLANNED PROGRAM ACCOMPLISHMENTS

FY 2011

- Evaluate innovative reactor systems and components to identify promising candidates for further research and development (R&D) as part of an integrated advanced reactor system concept.
- Evaluate transformational reactor concepts to identify technical challenges, system feasibility, and performance as compared to current Gen IV systems.
- Evaluate reactor coolant and balance of plant fluid heat transfer properties, performance, and chemical interactions.
- Continue advanced modeling techniques using the Department's high-speed, parallel computers for the development of close-coupled and integrated neutronic, thermofluid, and structural codes.
- Demonstrate the technical and economic viability of an advanced Brayton Cycle energy conversion system using supercritical carbon dioxide as the working fluid.
- Conduct nuclear data measurements and validation, specifically cross section and other nuclear data measurements needed for advanced fast reactor designs and safety validation.
- Conduct research for optimizing systems and components applicable to advanced reactor concepts, such as fuel handling devices and in-service inspection instrumentation.
- Continue international collaboration on advanced reactor system safety, performance, maintainability, and reliability improvement.
- Perform a technology gap analysis for the fluoride high-temperature reactor and develop an associated roadmap for addressing identified gaps.
- Complete the identification phase of the SFR system regulatory gap analysis and begin to assess gap significance and resolution approach.
- Perform an independent comparison and analysis of the different innovative advanced reactor technology options, and prioritize the options for future focused R&D efforts based on potential benefits and promise for fulfilling NE R&D Roadmap objectives.
- Continue participation in GIF committees and technical working groups.

FY 2012

- Further investigate and develop advanced reactor technologies with the potential to meet future energy demands in an affordable, proliferation-resistant, safe, secure, and environmentally friendly manner.
- Further the development of promising advanced reactor priority concepts identified from the independent assessment performed in FY 2011 and investigate promising transformational concepts.
- Continue R&D activities designed to reduce long-term technical barriers to advanced technology reactor systems through analysis, modeling, and small-scale experiments.
- Continue the development of innovative technology features, such as the S-CO_2 Brayton Cycle energy conversion system.
- Bring together the various reactor concept structural, system, and component level R&D products and innovations into an integrated reactor system design to confirm feasibility and benefits, and to identify areas requiring additional R&D.
- Significantly increase R&D work on the Fluoride-cooled High-Temperature Reactor (FHR), including modeling and materials tasks and trade-off studies that compare and analyze design options.
- Continue work in the areas of advanced reactor structural materials, safety research, nuclear data, and GIF and other international collaborative activities.

The Small Modular Advanced High Temperature Reactor (SmAHTR) uses a liquid salt coolant combined with high temperature gas-cooled reactors. SmAHTR operates at very high temperatures and is targeted for high efficiency electricity production or process heat applications.

Photo courtesy of Oak Ridge National Laboratory.