Next Generation Nuclear Plant Demonstration Project

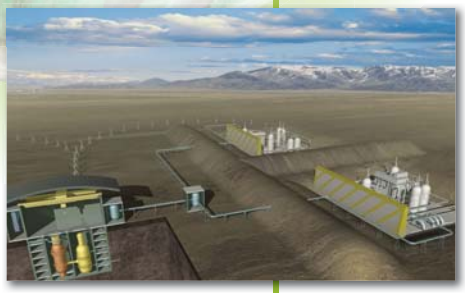
The U.S. Department of Energy's Office of Nuclear Energy

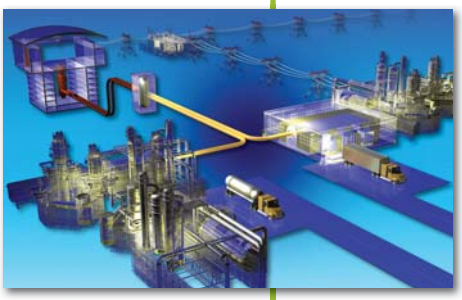
NGNP will extend the benefits of nuclear energy by providing carbon-free, high-temperature process heat to industry.

The Department of Energy (DOE) is laying the groundwork for a lower emissions future, free of reliance on imported energy. The Next Generation Nuclear Plant Demonstration Project (NGNP) is a vital part of this vision.

DOE's Next Generation Nuclear Plant (NGNP) Demonstration Project supports a transformative application of nuclear energy to address the President's goals for reducing greenhouse gas emissions and enhancing energy security.

BENEFITS OF THE NGNP PROGRAM





Through scientific and international collaboration, NGNP supports the development of gas-cooled nuclear reactor technology that promises improved performance in sustainability, economics, and proliferation resistance. As a result of these efforts, nuclear energy will increase its contribution to the reduction of CO_2 emissions when it is used to replace conventional sources of process heat, such as the burning of fossil fuels.

By investing in gas-cooled reactor technology that makes possible more efficient electricity production and the production of nuclear process heat for industry, NGNP is endeavoring to jump start a new application for nuclear energy with potential benefits to the environment that rival the reduction in greenhouse-gas emissions credited to current generation nuclear power plants.

The NGNP Demonstration Project will provide:

High-temperature gas-cooled reactor technology — Gas-cooled reactors are a revolutionary advance in reactor technology. They are inherently safe, efficient, and can use less fuel than the current generation of light-water reactor designs. Gas reactors can be used to extend the benefits of nuclear energy beyond the electrical grid by providing industry with low carbon, high-temperature process heat for a variety of applications, including petroleum refining, biofuels production, and production of chemical feedstocks for use in the fertilizer and chemical industries

Underlying Technologies — Underlying technologies (fuels, materials, neutronic and thermofluid modeling) benefit the majority of reactor concepts and sizes that are being investigated as part of the overall NE R&D portfolio.

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Program Budget

Next Generation Nuclear Plant
($ in Millions)

	FY 2010 Actual	FY 2011 Request
	$164.3	$103.0

PROGRAM BACKGROUND

The NGNP Demonstration Project was formally established by the Energy Policy Act of 2005 (EPAct 2005) to demonstrate the generation of electricity and/or hydrogen with a high-temperature nuclear energy source. The Project is executed in collaboration with industry, DOE national laboratories, and U.S. universities. The U.S. Nuclear Regulatory Commission (NRC) is responsible for licensing and regulatory oversight of the demonstration nuclear reactor.

The NGNP Demonstration Project includes design, licensing, construction, and research and development conducted in two phases. Phase 1 is pre-conceptual and conceptual design leading to the selection of a single technology for NGNP. Phase 2 is preliminary and final design necessary for licensing and construction of a demonstration plant. R&D as well as licensing activities are included in both Phase 1 and Phase 2. Licensing scope supports the development of a licensing framework for high-temperature gas reactors and includes the preparation and submission of a Combined Operating License Application (COLA) for the NGNP. R&D activities are organized into four major technical areas: (1) Fuel Development and Qualification, (2) Graphite Qualification, (3) High-Temperature Materials Qualification, and (4) Design and Safety Methods Validation.

INTERNATIONAL COOPERATION

The United States collaborates with the international community via the Generation IV International Forum (GIF), the International Atomic Energy Agency (IAEA), and through a number of bilateral agreements pioneered under the International Nuclear Energy Research Initiative.

PLANNED PROGRAM ACCOMPLISHMENTS

In FY 2010, the Department engaged with industry to complete conceptual designs for the NGNP. In the first quarter of FY 2011, the Nuclear Energy Advisory Committee will review the conceptual design reports along with the state of NGNP R&D and licensing activities and make recommendations on whether or not to proceed to Phase 2 of the project.

FY 2010

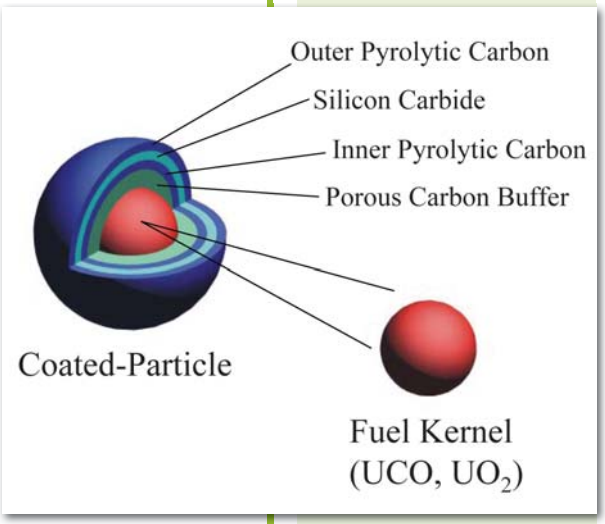
- Begin cost-sharing with industry to complete the conceptual design of one or two gas-cooled reactor concepts for the NGNP.
- Complete the first Advanced Gas Reactor fuel irradiation experiment, perform post-irradiation examinations of the irradiated fuel specimens, and commence irradiation of the first fuel produced in large-scale production equipment.
- Continue irradiation of the first Advanced Graphite Creep test experiment to provide data for nuclear graphite qualification.
- Continue the development of advanced gas reactor system-simulation software and initiate bilateral cooperation with Japan on the use of its experimental gas reactor as a test facility for code validation, operational experience, and as an instrumentation and controls test bed.
- Continue the study of liquid salt properties and materials issues associated with its use as a high-temperature medium for intermediate energy transport loops.
- Continue collaboration with the NRC on scale reactor tests to benchmark thermal-fluid reactor system modeling tools.

- Submit white papers to NRC on key licensing topics and resolve any comments.
- Continue international R&D collaborations through the Generation IV International Forum (GIF), IAEA, and bi-lateral agreements.

FY 2011

- Sponsor an independent review of NGNP activities by the Nuclear Energy Advisory Committee to inform a decision on readiness to proceed with Phase 2 of the NGNP Project.
- Enter into a cost-sharing public-private partnership to conduct the R&D, design, and licensing activities leading to NRC issuance of a Combined Operating License.
- Continue the irradiation in the Advanced Test Reactor (ATR) of the first NGNP fuel produced in commercial scale production equipment and complete post-irradiation examination of the first NGNP fuel removed from ATR in November 2009.
- Continue selection and characterization of NGNP graphite and composite materials, including the irradiation of the first graphite test experiment in ATR and the assembly of High-Temperature Vessel irradiation experiments planned for Oak Ridge National Laboratory.
- Continue environmental, mechanical property, and joining method (*e.g.* welding) studies for selected heat exchanger and reactor pressure vessel materials for code-case data package development and qualification.
- Continue topical report analysis and respond to Requests for Additional Information from the NRC, pending the availability of design data.
- Complete Regulatory Gap Analysis that will review existing NRC rules and regulations and identify their applicability to gas reactors.
- Continue international R&D collaborations through the GIF on fuels, materials, modeling, and process heat applications.
- Use existing test facilities (High-Temperature Test Reactor in Japan) and construction of separate effects and integral effects test experiments for validating NGNP thermal-fluid behavior and the capability of the passive system to remove decay heat.
- Conduct research on process heat applications, including system interface requirements and materials compatibility issues, for coupling NGNP to various non-electric applications.
- Continue fuel performance modeling, fabrication modeling, and fission product transport.

R&D focuses on enabling technologies such as high-temperature metal alloys, nuclear-grade graphites, and coated-particle fuels.



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