



Nuclear Hydrogen Initiative

Office of Nuclear Energy, Science and Technology
U. S. Department of Energy

February 2004

Goal of the Nuclear Hydrogen Initiative

The goal of the Nuclear Hydrogen Initiative is to demonstrate the economic, commercial-scale production of hydrogen using nuclear energy. If successful, this research could lead to a large-scale, emission-free, domestic hydrogen production capability to fuel a future hydrogen economy.

Why Use Nuclear Energy to Produce Hydrogen?

Hydrogen offers significant promise as a future energy technology, particularly for the transportation sector. The use of hydrogen in transportation will reduce U.S. dependence on foreign sources of petroleum, enhancing our national security. Significant progress in hydrogen combustion engines and fuels cells is making transportation by hydrogen a reality.

The primary challenge to the increased use of hydrogen as part of the Nation's overall energy infrastructure is the cost associated with its production, storage and delivery. Hydrogen is the most common element in the universe and can be produced from readily available sources such as methane and water. However, existing hydrogen production methods are either inefficient or produce greenhouse gases. Nuclear energy has the potential to efficiently produce large quantities of hydrogen without producing greenhouse gases and hence, to play a significant role in hydrogen production.

Developing an Integrated Hydrogen Program

The President's Hydrogen Fuel Initiative is a new research and development effort to reverse America's growing dependence on foreign oil and expand the availability of clean, abundant energy. Hydrogen is produced today on an industrial scale in the petrochemical industry by a process of steam reforming, using natural gas as both source material and heat source.

Recent research conducted under the Department's Nuclear Energy Research Initiative (NERI) indicates the possibility of hydrogen production through the thermochemical splitting of water. Nuclear heat, supplied to a hydrogen-producing thermochemical plant through an intermediate heat exchanger, promises high efficiency and avoids the use of carbon fuels. Using very-high-temperature advanced reactors, such as Generation IV gas-cooled or liquid metal-cooled

reactors, nuclear energy can produce hydrogen in very large quantities consistently over long periods of time without emitting greenhouse gases or other harmful air emissions. The Department is also exploring several other processes, including the high-temperature electrolysis of water.

Significant research and development (R&D) will be required in order to complete a commercial-scale demonstration. The hydrogen production system and heat transfer components, such as intermediate heat exchangers, will require the evaluation and development of high-temperature, corrosion-resistant materials.

The Office of Nuclear Energy, Science and Technology (NE) has developed a Nuclear Hydrogen R&D plan, which defines the objectives and goals of the Nuclear Hydrogen Initiative and identifies the R&D required to deploy the most promising technologies.

As part of the President's Hydrogen Fuel Initiative, the Nuclear Hydrogen Initiative is being implemented in close cooperation with programs in other DOE offices that are conducting hydrogen R&D -- the Offices of Energy Efficiency and Renewable Energy, Fossil Energy, and Science. This cooperation eliminates redundancy while ensuring that R&D is complimentary. NE has also established substantial cooperation in this area with its international research partners.

Program Highlights

The Nuclear Hydrogen Initiative addresses the need for greater utilization of our energy resources by developing energy conversion systems to economically produce hydrogen for use in our national transportation system.

Program milestones include:

- FY 2006: Complete a demonstration of laboratory-scale thermochemical and high-temperature electrolysis hydrogen production systems.
- FY 2010: Begin operation of a pilot-scale hydrogen production system.
- FY 2013: Complete the final design of a commercial-scale nuclear hydrogen production system.

- FY 2014: Initiate construction of the commercial-scale nuclear hydrogen demonstration facility.
- FY 2017: Complete construction and checkout of the nuclear hydrogen demonstration facility and initiate demonstrate of commercial-scale hydrogen production.

FY 2003 Accomplishments:

- A Nuclear Hydrogen R&D Plan was developed that defined and prioritized the necessary R&D to develop, design and construct hydrogen production facilities.

FY 2004 Planned Accomplishments:

- Complete final designs for the baseline thermochemical and high-temperature electrolysis laboratory-scale systems.
- Prepare report identifying materials requirements for baseline hydrogen production processes.
- Prepare report identifying potential applications for membranes in nuclear-compatible hydrogen production processes.

- Identify infrastructure requirements for the pilot plant demonstration of hydrogen production processes.

FY 2005 Planned Accomplishments:

- Complete conceptual design and begin preliminary design for the baseline thermochemical and high-temperature electrolysis pilot plants.

Program Budget Nuclear Hydrogen Initiative (\$ in Millions)		
FY 2003 <u>Appropriation</u>	FY 2004 <u>Appropriation</u>	FY 2005 <u>Request</u>
\$2.0*	\$6.4	\$9.0

* \$2M included in Nuclear Energy Technologies budget for R&D on nuclear hydrogen production technologies.

Planning for the President’s Hydrogen Fuel Initiative



Visit our web site: nuclear.gov