U. S. Senate
Committee on Energy and Natural Resources

Sections 641 through 645, Energy Policy Act of 2005
Next Generation Nuclear Plant Project within the Department of Energy

Statement of Jeffrey Serfass
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Chairman Domenici, Senator Craig and other Honorable Members of the Committee: On behalf of the members of the National Hydrogen Association (NHA), I would like to speak to you today regarding the implementation of the Next Generation Nuclear Plant (NGNP) Project within the Department of Energy, as this effort may affect our country's transition to a hydrogen economy. For over 17 years, the National Hydrogen Association has been dedicated to research, development and demonstration of hydrogen and fuel cell technologies, leading to a firm basis for establishing and growing a commercial hydrogen economy. Our extensive work in safety, codes and standards, education and outreach, and policy advocacy have gotten us to the edge, indeed the beginning, of the transition to hydrogen.

Our 103 members represent the considerable diversity of the community interested in the future hydrogen economy: large energy and automobile firms, utilities, fuel cell and electrolyzer manufacturers, small businesses, transportation agencies, national laboratories, universities and the many other researchers, developers and manufacturers of hydrogen energy products. In partnership with the U.S government and each other, we are the wave front of technical and economic action on hydrogen in the U.S. and abroad — these are the people and organizations that are making great progress along a broad technical front, and will have a key role in implementing these technologies (please see the attached list of members and our Board of Directors.)

Summary My testimony will make the following points that reflect the NHA's policy positions:

- Hydrogen is critical for our energy future to achieve energy security, environmental health and economic growth objectives.
- The transition to hydrogen has already begun, with early products on the market, and it is accelerating.
- The introduction of hydrogen vehicles into early markets is just around the corner.

- A hydrogen economy capable of fueling our transportation needs will require a large amount of hydrogen with new production capacity.
- Nuclear power can provide a significant portion of the new hydrogen required, with no greenhouse gases or other pollution, providing that waste management and safety issues are addressed.
- The Generation IV Modular Helium Reactor (MHR) planned for NGNP solves the waste management and safety issues.
- The NGNP high efficiency electric generation is well suited for hydrogen production with today's low temperature electrolysis, and NGNP high temperatures allow it to produce hydrogen with new high temperature electrolysis and/or direct thermochemical water splitting.
- The future hydrogen economy needs the nuclear option and this program is the best way to get there in the required time frame.

Hydrogen is our Nation's Premier Energy Destination

The President's Hydrogen Fuel Initiative, expanded and permanently authorized by the Energy Policy Act of 2005, provide the framework for a significant transformation of our energy and transportation systems. The U.S and countries around the world are embarked on this transition to hydrogen as a fuel because it provides benefits to energy security, the environment and economic growth:

1. Hydrogen can help energy security because it can be produced by a variety of resources, contributing to the development of alternatives to imported oil for transportation, and fueling distributed fuel cell power generation;
2. Hydrogen can benefit the environment because it can be produced and used in ways that have minimal impact on health-related air quality and on greenhouse gas emissions; and
3. Hydrogen can benefit economic growth through more efficient energy systems, new businesses and in-country production of transportation fuels resulting in new jobs.

We will need an army of dedicated and talented people to solve all the technical and market-building challenges along the way. We will need a robust set of options for producing, storing and using the hydrogen, just as we currently have multiple paths to the production and use of electric energy. The stakes are high and we have a lot of work to do to get to the future we believe is achievable.

The Transition Has Begun and Is Accelerating

Products to produce and use hydrogen are in use today, and the pace of growth in hydrogen's use will accelerate over the next 10 to 20 years as the technologies and the infrastructure evolve. There are emerging products in three key areas:

- Stationary power generation for power at remote sites and for grid-isolated applications
- Portable electronics using micro-fuel cells in computers, cameras, surveillance equipment, military personnel power and cell phones
- Transportation, including fork lifts, personal mobility vehicles and soon, buses, cars and possibly trains.

These early products, today's development of niche markets, and the DOE-sited progress in meeting key system goals suggest that we are already on the technology and market growth curve toward the hydrogen economy.

The Introduction of Hydrogen Vehicles is Just Around the Corner

DOE's hydrogen program in EERE is focused on technology readiness by 2015 for hydrogen-fueled transportation. Congress has funded and DOE has implemented an impressive program to address the technology challenges, in addition to the Fossil Energy and Nuclear Energy programs funded separately

As early as 2015 is, National Hydrogen Association members are moving even more aggressively. The manufacture and introduction of competitive technologies, market creation and development, and customer positioning by industry are indicating that commitments to early production vehicles is happening now. We will have early commercial vehicles on the road in the next few years from several manufacturers. The pace is faster than one could have expected even a few years ago. Industry is driven to the creation of world market vehicles that address environmental issues and petroleum constraints.

The supporting infrastructure is developing, too. The NHA's new website which provides a database of operating and planned hydrogen fueling stations in the U.S. and Canada shows a total of 37 operating hydrogen fueling stations already and another 22 planned. The infrastructure development is out ahead of the market and will be ready for early fleets in urban areas, and increasingly to connect hydrogen highways planned in a number of states and border nations.

A Hydrogen Economy Will Require Large Amounts of Hydrogen

No single hydrogen production strategy will be sufficient for the U.S. Although 95% of hydrogen today is produced by the steam reforming of fossil fuels, the hydrogen economy of the future will require hydrogen produced by a variety of resources, including renewable energy, nuclear and coal. Large amounts of hydrogen will be required and, just as in electricity production, different resources will be used in different regions, in different markets, and for different applications. It is through resource diversity that hydrogen will be one of two clean and secure energy carriers of the future. Electricity is the other energy carrier.

A hydrogen economy will require significant new hydrogen production, even with the increased efficiency of the automobile fleet through fuel cells and lighter weight vehicles. While it is expected that coal, with carbon capture and management, and renewable energy will be significant contributors, nuclear is expected to be required, in the U.S, and even more so in countries that lack the coal resources that the U.S. has.

The U.S. Energy Information Administration said U.S. annual gasoline usage in 2000 was 129 billion gallons, which is comparable to 129 billion kg of hydrogen if hydrogen were the replacement fuel. To provide an accurate comparison, it is important to note that hydrogen-fuel cell vehicles are more than twice as efficient as today's

internal combustion engine vehicles. So let's say the annual hydrogen need is 65 billion kg for a fully hydrogen light weight vehicle fleet. The NHA reports that a manufacturer can produce hydrogen and compress it for vehicle storage with 60 kWh per kg of hydrogen, so the electric energy required with today's electrolysis technology is nearly 4,000 billion kWh, requiring about 2 million MW of electric generation capacity. With the higher hydrogen-producing efficiency of the NGNP plant, this volume of hydrogen would require only 1 million MW of new capacity. If 20 to 50% of the new hydrogen mix is nuclear, we would need approximately 60 to 150 new 3,000 MW plants in this country alone, and this new U.S. technology will be exportable to countries with far fewer domestic energy resources than the U.S. has.

Nuclear energy can produce high quality hydrogen in large quantities at a relatively low cost without any air emissions. Most importantly, large volumes of hydrogen can be produced by nuclear with investments by government and industry to develop the technology, and investments by industry to build the plants.

Nuclear Power Can Provide a Significant Portion of the Hydrogen Required, with Waste Management and Safety Issues Addressed

The National Hydrogen Association's position is that nuclear is an important component of the hydrogen production resource mix because, as with coal, hydrogen can be produced in great volumes to support a worldwide growing hydrogen energy market. However, nuclear waste management issues must be solved, with acceptable strategies for disposal of current and projected wastes to minimize the problem. Further, safety issues must be addressed, not because the safety record is poor today (the record is exceptional), but because the public will expect that future nuclear plants need to be designed to even higher safety standards, and be passively safe.

It is important to keep in mind that there are risks and issues with all energy production and use and there will be risks with hydrogen production and use, just as there is with gasoline and electricity. The beauty of the hydrogen future is that it is clean and secure. Our hydrogen production methods must meet those objectives, too. Nuclear is clean, and it must be safe.

The Next Generation Nuclear Plant Solves the Waste Management and Safety Issues

The most promising nuclear hydrogen production technologies will likely use the high temperature gas reactor (HTGR) that is the fundamental technology behind the NGNP project. Its high temperature hydrogen production processes are more efficient (overall efficiency of ~50% or twice that of today's nuclear Light Water Reactors with low temperature electrolysis) and will be able to provide more economical, large-scale hydrogen production with greatly reduced waste and significantly increased safety.

The NGNP is Well Suited for Hydrogen Production in the Time Frame Needed

The NGNP project will lead to high temperature processes that can produce hydrogen in three different ways:

1. ***Conventional Electrolysis*** -- Currently, the best way to produce hydrogen from nuclear energy is with conventional electrolysis. This can be done by today's Light Water Reactors and tomorrow's higher temperature reactors by electrically splitting water into its components, hydrogen and oxygen. The high efficiency of the Next Generation Nuclear Plant will produce hydrogen from conventional electrolysis more efficiently than today.

2. ***High Temperature Electrolysis*** -- The high NGNP temperatures can be used in high temperature electrolyzers under development, capable of producing hydrogen at even greater efficiency than conventional electrolysis. High temperature electrolysis uses heat from the reactor to replace some of the premium electricity required in conventional electrolysis.

3. ***Thermochemical*** -- High temperature steam can be used to produce hydrogen directly, thermochemically, bypassing electrolysis with even greater efficiency. The necessary chemical reactions take place at high temperatures (450-1000° C), temperatures that are available in NGNP processes.

EPAct 2005 Section 645 lays out timelines which are consistent with the growing need for hydrogen in 2020 to 2050. The prototype construction operation by 2021 is needed to allow investments later in the decade and beyond for full scale hydrogen production.

The Future Hydrogen Economy Needs the Nuclear Option and NGNP Is the Best Way to Get There.

We thank you for the opportunity to provide this testimony. We look forward to continuing a fruitful working relationship with the Committee, its staff, and all our stakeholders in building a successful Hydrogen Economy.

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