581e Economic Analysis of Hydrogen Production Via Water-Splitting Using Nuclear Energy

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As President Bush acknowledged in his January, 2003, State of the Union address, hydrogen has the potential to play a major role in America's future energy system. The U.S. Department of Energy (DOE) recognizes that development of this abundant element as an "energy carrier" would help address growing national concerns about energy supply, security, and environmental protection. Use of nuclear energy to split water has emerged as one of the leading contenders for the production of hydrogen on a scale comparable to that of a transportation fuel. As a result, the DOE Office of Nuclear Energy, Science & Technology has created the Nuclear Hydrogen Initiative (NHI) program with the objective of developing production technologies that can be most effectively coupled to next generation nuclear reactors for large-scale hydrogen production.

A variety of alternatives have been proposed for water-splitting using nuclear energy. The simplest (and least thermally efficient) is direct electrolysis at low temperature, with electric power supplied by a nuclear power plant. Another, more thermally efficient option is to use high temperature, steam electrolysis coupled to an advanced, next generation nuclear heat and power plant. Still other choices are available from the myriad thermochemical cycles that have been proposed, which use high temperature heat from an advanced nuclear heat and power source to drive a net endothermic, closed set of chemical reactions that split water into its elemental components. The NHI is supporting development of several thermochemical cycles as well as high temperature electrolysis for hydrogen production using nuclear energy.

The Savannah River National Laboratory (SRNL) has undertaken a comparison of the various hydrogen production methods being developed for the NHI, using a combination of performance data obtained from the literature and projections based on flowsheet model calculations. This paper will present the results of that study. The projected efficiencies, capital costs, and unit hydrogen production costs for these processes will be compared against each other.