U.S. DEPARTMENT OF ENERGY
INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE
DOE/Canada

ABSTRACT

Lower-Temperature Thermochemical Hydrogen Production

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Collaborators: Chalk River Laboratories, Gas Technology Institute (GTI)

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The goal of this project is to evaluate the commercial viability of matching the Cu-Cl cycle with the Super-Critical Water Reactor (SCWR) being considered within the DOE-NE Generation IV program. The availability of alternative hydrogen production processes has been recognized in the DOE-NE Nuclear Hydrogen R&D Plan as an important element in the Nuclear Hydrogen Initiative. The Cu-Cl cycle was identified as a promising low temperature cycle from studies at ANL funded through internal Laboratory-Directed Research and Development (LDRD) resources. Proof-of-principle experiments and thermodynamic feasibility studies have been completed. The maximum temperature required is 530°C in laboratory scale experiments. All of the thermal reactions go to completion with minimal side production formation. This cycle also contains an electrochemical step for which GTI has significant expertise. Preliminary experiments with their graphite electrodes and a recently patented membrane design have demonstrated excellent performance. These results along with the reduced thermal burden and the potential ability to match a wider range of reactor concepts justifies further development of the family of Cu-Cl cycles.

ANL proposes further development of the cycle in order to provide the data for the simulation necessary to cost hydrogen production using Cu-Cl chemistry and heat from the SWCR. ANL proposes the following experimental and simulation work; (1) simulations using commercial process design programs to optimize process design and to calculate cycle efficiency and (2) experimental work, e.g., reaction kinetics, design and testing of various reactor configurations, etc., as required for the simulation. GTI proposes further development of the electrochemical cell.

AECL proposes the following: (1) to study the interface of low temperature thermochemical cycles and other hydrogen production methods with an SCWR; (2) to work with ANL to optimize heat matching between the cycle and the power plant, (3) to determine the overall efficiency of the combined plants, and (4) to project the costs associated with hydrogen production and cogeneration. AECL's focus will also include the costs of distributing and maintaining dependable hydrogen supply for the various combinations of hydrogen production methods and the SCWR and comparison with other hydrogen-production technologies.