GA-C23317

HIGH EFFICIENCY GENERATION OF HYDROGEN FUELS USING NUCLEAR POWER

**for the period
November 1, 2001 through January 31, 2002**

**by
L.C. BROWN**

**Prepared under
Nuclear Energy Research Initiative (NERI)
Program. DE-FG03-99SF21888
for the U.S. Department of Energy**

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**GENERAL ATOMICS PROJECT 30047
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High Efficiency Generation of Hydrogen Fuels Using Nuclear Power

Nuclear Energy Research Initiative (NERI)
Program DE-FG03-99SF21888
Technical Progress Report
November 1, 2001 through January 31, 2002

HIGHLIGHTS

The size of the nuclear reactor used in the matching has been assumed to be 2400 MWt.

INTRODUCTION

Future nuclear reactors will operate at higher efficiencies and, therefore, at higher temperature than current reactors. High temperatures present the potential for generating hydrogen at high efficiency using a thermochemical process. Thermochemical cycles for the generation of hydrogen from water were extensively studied in the 1970s and early 1980s both in the U.S. and abroad. Since that time, thermochemical water-splitting has not been pursued in the U.S. at any significant level. In Phase 1, we reviewed and analyzed all available data to determine the process best suited to hydrogen production from the advanced nuclear reactors expected to be available in the next 20 to 30 years. The Sulfur-Iodine Cycle was selected for detailed study in Phases 2 and 3. In Phase 2, we investigated means of adapting this cycle to the heat output characteristics of an advanced high temperature nuclear reactor. In Phase 3, we are integrating the cycle and reactor into a unified hydrogen production plant.

OVERALL ASSESSMENT

The three participants: General Atomics (GA), Sandia National Laboratories (SNL) and the University of Kentucky (UK) all are working on Phase 2 tasks. Table 1 indicates the scheduled completion date of each task and actual completion date for completed tasks. Each organization participates, and to some extent in every task, but the lead organization is indicated on the task schedule, Fig. 1. The overall project is slightly behind schedule.

STATUS, ISSUES AND CONCERNS

Phase 3

Develop Concepts for Auxiliary Systems (WBS Element 3.1)

This task has started at SNL. The hydrogen plant is being designed to match a 2400 MWt high-temperature helium cooled reactor. This size corresponds to a four 600 MWt modules of a passively safe Modular Helium Reactor. Two options are considered: (1) the hydrogen plant is matched using only thermal energy, and (2) part of the plant is matched using high temperature thermal energy and part is matched using the reject heat from a Brayton power cycle.

Table 1
Summary of NERI Tasks — Phases 1–3

Identification Number	Milestone/ Task Description	Planned Completion Date	Actual Completion Date	Comments
1.1	Literature survey of new processes	Fri 2/25/00	Fri 2/25/00	Completed on schedule
1.2	Develop screening criteria	Fri 10/1/99	Fri 10/1/99	Completed on schedule
1.3	Carry out first round screening	Fri 3/10/00	Fri 3/10/00	Completed on schedule
1.4	Short report on conclusions	Fri 3/31/00	Fri 3/31/00	Completed on schedule
1.5	Carry Out Second Round Screening	Fri 6/2/00	Tue 5/9/00	Completed ahead of schedule
1.6	Write Phase 1 report	Fri 6/30/00	Fri 6/30/00	Completed on schedule
2.1	Carry out detailed evaluation of few processes to select one	Fri 1/26/01	Fri 1/26/01	Completed on schedule
2.2	Define reactor thermal interface	Fri 3/2/01	Tue 7/31/00	Completed behind schedule
2.3	Preliminary engineering design of selected process	Fri 3/2/01	Tue 7/31/00	Completed behind schedule
2.4	Develop flowsheet	Fri 6/29/01	Tue 7/31/00	Completed behind schedule
2.5	Conceptual equipment specifications	Fri 6/29/01	N/A	Work postponed to Phase 3 as task 3.3
2.6	Write Phase 2 Report	Fri 8/31/01		Work in progress
3.1	Develop concepts for auxiliary systems	Fri 6/28/02		Work not begun
3.2	Refine flowsheet	Fri 6/28/02		Work in progress
3.3	Conceptual equipment specifications	Fri 6/28/02		Work not begun
3.4	Size/cost process equipment	Fri 7/12/02		Work not begun
3.5	Evaluate process status	Wed 7/31/02		Work not begun
3.6	Write Final Report	Wed 7/31/02		Work not begun

Fig. 1. Project schedule.

Refine Flowsheet (WBS Element 3.2)

This task is progressing at UK. The pressures of the various sections of the sulfuric acid concentration and decomposition section are being varied to optimize heat recovery within this section of the process.

Conceptual Equipment Specifications (WBS Element 3.3)

This task has not started.

Size/cost Process Equipment (WBS Element 3.4)

This task has not started.

Evaluate Process Status (WBS Element 3.5)

This task has not started.

NEXT QUARTER'S WORK

Work on tasks 3.1 and 3.2 will continue.

Fig. 2. Spending profile.