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HIGH EFFICIENCY GENERATION OF HYDROGEN FUELS USING NUCLEAR POWER

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November 1, 1999 through January 31, 2000

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 1999 through January 2000

Highlights

- The literature database now contains over 800 entries.
- The water-splitting cycle database contains 105 cycles.

Overall Assessment

The three participants: General Atomics (GA), Sandia National Laboratories (SNL) and the University of Kentucky (UK) are all meeting their respective goals. Table 1 indicates the tasks to be performed and the status of each task. Each organization participates, to some extent in every task but the lead organization is indicated on the task schedule, Fig. 1. All tasks are proceeding on schedule. No tasks were scheduled for completion during the past quarter. The spending profiles for all three organizations are given in Fig. 2. Spending at SNL is slightly behind the constant spending rate used in the projection but is in line with the actual project needs.

Issues and Concerns

Task 1.1 Literature Survey – none

Task 1.2 Establish screening criteria – complete

Task 1.3 First round screening – none.

Literature Survey – Task 1.1

We continued searching various databases for references relating to thermochemical cycles for watersplitting, as described in the first quarterly report. During this period the NTIS database and the DOE PubSCIENCE database (<http://www.osti.gov/pubsci>) were searched in addition to CAPLUS, the Chemical Abstracts database previously identified as our prime source. The references obtained from all searches have been accumulated in an EndNote literature database. EndNote is a widely accepted and readily available database program designed to manage bibliographic information. Each EndNote entry includes the bibliographic entry, tracking information and, if available, an abstract.

Currently the EndNote database contains 822 entries. New references are added as they are obtained and duplicates or references that are not relevant are purged. Figure 3 indicates when the references were published. The last review of the subject was published in 1988, just as the major funding in this area ceased worldwide. Since that time about eight papers per year have been published.

Information on each individual thermochemical cycle is maintained in a second project database using MS Access. This database contains the details of the chemical reactions and process conditions for the process, as well as the abbreviated bibliographic information literature references which describe or refer to the cycles. At this time, there are 105 cycles in the Project Database. A special effort is being made to identify new cycles, such as that described by Y. Tamaura in a 1995 publication. He describes a novel, two-step watersplitting cycle, employing manganese ferrites, which he claims can be operated at a maximum temperature somewhat above 1073 K.

First Round Screening – Task 1.3

The 105 cycles, as well as cycles yet to be added, are being screened using the criteria described in the first quarterly report. Each cycle has been assigned to a team member who is checking it for chemical and thermodynamic feasibility and who will champion it during the screening process. The down selection to 20–30 cycles will be completed at a meeting at General Atomics in early March.

Next Quarter's Work

The next quarter a number of tasks are scheduled to start or to be completed. The literature survey is scheduled for completion on February 25th and the first round screening is scheduled to be completed March 10th. The report on the screening should be completed by March 31st and will be issued shortly after. Following completion of the first round screening, work will commence on the detailed evaluations necessary to reduce the number to cycles under consideration to, at most, three.

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		Work in progress and 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		Work in progress and on schedule
1.4	Short report on conclusions	Fri 3/31/00		Work not begun
1.5	Carry Out Second Round Screening	Fri 6/2/00		Work not begun
1.6	Write Phase 1 report	Fri 6/30/00		Work not begun
2.1	Carry out detailed evaluation of few processes to select one	Fri 9/29/00		Phase 2
2.2	Define reactor thermal interface	Fri 9/29/00		Phase 2
2.3	Preliminary engineering design of selected process	Wed 11/22/00		Phase 2
2.4	Develop flowsheet	Fri 4/20/01		Phase 2
2.5	Conceptual equipment specifications	Fri 5/4/01		Phase 2
2.6	Write Phase 2 Report	Fri 6/30/01		Phase 2
3.1	Develop concepts for auxiliary systems	Fri 10/26/01		Phase 3
3.2	Refine flowsheet	Fri 1/11/02		Phase 3
3.3	Size/cost process equipment	Fri 3/22/02		Phase 3
3.4	Evaluate process status	Fri 5/3/02		Phase 3
3.5	Write Final Report	Fri 6/28/02		Phase 3

Fig. 1. Project Schedule.

Fig. 2. Spending Profile.

Fig. 3. Publications by Year of Issue.