SANDIA NATIONAL LABORATORIES
HYDROGEN STORAGE DEVELOPMENT PROGRAM

QUARTERLY PROGRESS REPORT FOR OCTOBER-DECEMBER 2006.

TASK 1.2 COLLABORATIVE WEBSITE SUPPORT (STORAGE CENTERS & PROJECTS QUICKPLACE)

AUTHOR: MARCINA MORENO

At the request of DOE, Sandia National Laboratories developed the Storage Centers & Projects QuickPlace in May 2005 for the purpose of sharing information in a secure environment among Hydrogen Storage colleagues and partners. The folders maintained within the website provide dated records of documents posted by various participants of the group. Sandia will continue to maintain the membership list as approved by DOE and to provide posting services upon request for the restricted member private rooms: (1) DOE Hydrogen Storage (default all), (2) Center Leads and (3) SSAWG.

Jennifer Freitas (jfreita@sandia.gov) maintains the website and membership list, acts as liaison between QuickPlace Administrators (technical support group) and the DOE Hydrogen Storage Program QuickPlace members, and provides posting services upon request. Marcina Moreno (mamore@sandia.gov) continues to be the point of contact for DOE and room managers for membership authorizations, training and any other concerns.

Since the user tracking website commenced during February 2006 (https://sierra-nk.son.sandia.gov/QuickPlace/h2storage-sl/Main.nsf/h_Toc/9883355257F03FD280256CFB005221E3/?OpenDocument), the site has recorded 610 hits from its primary membership base of Hydrogen Storage colleagues.

TASK 2 DOE ROUND ROBIN TESTING PARTICIPATION

There was no activity under this task during Q1 of FY 2007.

TASK 3: IEA AND OTHER DOE DUTIES –GARY SANDROCK

AUTHOR: GARY SANDROCK

SUBTASK 3.1 IEA(HIA)/DOE/SNL HYDRIDE DATABASE

Reference: http://hydpark.ca.sandia.gov

The Hydride Information Center, a US contribution to the IEA HIA, was established in 1995 with DOE funding and a Sandia National Laboratories dedicated web server. It has been a widely-used and well-known tool of the hydride community ever since. It is my job to peruse the hydride literature and periodically update the databases, as well as answer user inquiries on the

contents. After several months off-line, the database was relaunched on the public SNL server in early December. Compared to the old dedicated server, database searching is now much faster and more efficient. In addition, the access problem (associated with certain government and industry firewall barriers) should now be eliminated. The Meetings & Symposia database might be especially useful for travel planning purposes. Collection of new hydride publications continued during the Quarter. George Thomas has reestablished his involvement with the databases. The database effort has been tentatively approved as a US project component of new IEA HIA Task 22. I shall report on the database progress at the upcoming Task 22 Workshop in Monterey CA, Jan. 29 – Feb. 1, 2007.

SUBTASK 3.2 IPHE AND OTHER AD HOC ASSISTANCE TO DOE

This Subtask covers a number of miscellaneous activities performed for DOE and/or SNL. At DOE's request, I also serve as an informal liaison between IPHE and IEA HIA storage activities. The following duties were performed during the Quarter:

1. MH2006 Attendance – I was the DOE HQ delegate to the International Symposium on Metal-Hydrogen Systems, Maui HI, Oct. 1-6, 2006. I chaired sessions and participated in International Steering Committee Meetings (including chairing the Ewald Wicke Award Committee). I provided debriefing contributions to the HFCIT Storage Team.

2. IEA HIA Task 17 Final Report – Although my duties as Task 17 Operating Agent ended with FY06, for information purposes, I include the following on the disposition of the 200+ page Final Task Report I submitted at the end of September 2006. The Report was formally approved, without change, by the IEA HIA Executive Committee during its semiannual meeting held in early November 2006. The Final Report has been (or will be) published in three forms:

A. It has already been electronically published as a series of PDF files on the IEA HIA website (http://www.ieahia.org/page.php?s=static&p=task17).

B. The report will be printed in hardcopy form (about 250 copies), with special financial support from the EC (JRC Petten).

C. During 2007, NEDO plans to translate the entire report into Japanese for widespread government, industry, national laboratory and university distribution within Japan.

This concludes my DOE-supported duties and activities for IEA HIA Task 17.

TASK 4 STORAGE CONSULTATION – GEORGE THOMAS

AUTHOR: DR. GEORGE J. THOMAS

SUBTASK 4.1 FREEDOMCAR AND FUEL PARTNERSHIP HYDROGEN STORAGE TECHNICAL TEAM

As a member of the Hydrogen Storage Technical Team, Dr. Thomas participated in the three scheduled monthly meetings of the team during this period. The October meeting, held on Oct.13, 2006, focused on work sponsored within the NCMS (National Center for Manufacturing Sciences) project. These included presentations on composite tank manufacturing and fuel cell manufacturing technologies, membrane manufacturing and fuel cell seals. In addition, T. Fitzsimmons, Office of Basic Energy Sciences, provided an overview of the BES projects on hydrogen storage. The November hydrogen storage tech team meeting, held on Nov. 9, 2006, concentrated on a discussion of the current DOE/FreedomCAR and Fuel Partnership storage system targets. Dr. Thomas also presented a brief presentation regarding technical inputs requested by VSATT (Vehicle Systems Analysis Tech Team) from the storage tech team. On Dec. 19, 2006, the storage tech team met in Detroit, MI and heard presentations by a number of independent projects in the storage portfolio. These included a presentation by UNLV on their comprehensive congressionally directed project and presentations by UTRC on their storage materials development project as well as their storage system engineering work.

SUBTASK 4.2 DETAILEE TO HFCIT

Dr. Thomas began the second year of his on-site assignment in Washington, DC, at the Department of Energy Office of Hydrogen, Fuel Cells and Infrastructure as a member of the Hydrogen Storage Team. His assignment is to provide scientific and technical input and feedback on research and development plans and on the projects that are part of the U.S. "National Hydrogen Storage Project".

During this quarter, Dr. Thomas participated in numerous discussions (by teleconference) with principal investigators on aspects of their hydrogen storage work, as well as periodic meetings (also by teleconference) with directors of the three Centers of Excellence.

On Oct. 9-10, 2006, he participated in the Ammonia Fuel Conference held in Golden, CO and presented a paper entitled “Potential Roles of Ammonia in a Hydrogen Economy: Public Opinion and Input.” This talk was based on the report on ammonia previously completed (co-authored with G. Parks, Conoco Phillips) for the DOE and tech team, but included a summary of the public comments the report received during the time it was posted on the DOE web site.

Dr. Thomas also attended other meetings during this period. On Nov. 13-14, 2006, he participated as a DOE representative in a face-to-face meeting held by the Chemical Hydride Center of Excellence in Denver, CO. On Dec. 12, 2006, he continued his active participation in the Storage System Analysis Working Group during a meeting held in Washington, DC, and also attended a proposal review panel meeting on Dec. 12-13, 2006. He also attended the hydrogen storage symposium during the Materials Research Societies Fall meeting in Boston, MA, where he presented a paper for R. K. Ahluwalia, ANL.

TASK 6 IEA / IPHE PARTICIPATION

SUBTASK 6.1 HYDROGEN MATERIALS: COMPLEX ANIONIC HYDRIDES

AUTHOR: EWA RONNEBRO

The objective of this subtask is to support participation at the IEA HIA Task 22 Experts Meetings and report on progress on the search for new light-weight, high-capacity complex metal hydrides for reversible on-board hydrogen storage guided by theory.

Novel, light-weight, high-capacity metal hydrides have been determined to be potential candidates for on-board materials that will shrink the growing gap between experimental result and the desired goals. For our project, the discovery process involves preparation methods in the solid state; mainly ball milling and the high-pressure sintering technique (P <140MPa, T <773K). By utilizing different ball milling approaches in collaboration with our MHCoE partners, we are able to control the size of the particles which is crucial for creating diffusion paths for hydrogen. The high-pressure vessel that enables six sample holders has been proven to be an effective tool for discovering/screening for new hydrides in different ternary systems.

Earlier in FY06, we initiated an investigation of the ternary Si-system, to rule out the possibility to stabilize Si-H anionic complexes in a matrix of cations. This approach is different from the process used by HRL. We found a new phase in the Na-Si-H system by ball milling mixtures of NaH and Si followed by high-pressure sintering, but even though NMR analysis (JPL/LLNL) indicated hydrogen content, the neutron spectroscopy (NIST) indicated very little hydrogen. Thus, we tried new synthesis routes in collaboration with HRL and U. Utah, including reactive milling. This quarter Sandia received ball-milled samples from both partners. HRL milled (in Argon) five samples in the Na-Si-H and Ca-Si-H systems, and at SNL we sintered them at high-pressures. According to XRD, the samples from HRL did not show any new phases at the chosen pressure and temperature. We also received three samples in the Na-Si-H system from U. Utah that were milled in hydrogen atmosphere, and at SNL, we high-pressure sintered these samples. The XRD-patterns of the three Utah-samples have very similar appearance. The samples contain mostly NaH and Si. The new peaks are small, only ca 5-10% yield. It is interesting to note that these peaks are different from the new peaks that we found at SNL. At SNL we used a different ball milling technique (SPEX mill, Ar-atmosphere) before high-pressure sintering of the sample. Since it is difficult to get a high yield of the new phases in the Na-Si-H system and since the hydrogen-content is very low, we will likely not pursue this system any further. We may though use Si in combination with other elements when investigating other systems. For more information, please contact the Principal Investigator.

We have also continued exploring other ternary systems and recently found new compounds in the ternary Ge and Mn systems. Reproduction and analysis is currently in progress.

Collaboration was initiated with U. Utah, to utilize their reactive milling capability to prepare new materials phases in the Mg-Ti-H and Li-Ti-H systems.

Eric Majzoub and Ewa Ronnebro participated in the IEA workshop in Monterey, CA on Jan 28-Feb 1 and presented a new project which was accepted.

SUBTASK 6.2 HYDROGEN STORAGE MATERIALS SAFETY

There was no activity under this task during Q1 of FY 2007.