ANNEX XIII

To the Agreement Between the Department of Energy
of the United States of America
and the Ministry of Energy and Infrastructure of Israel
in Energy Research and Development
Theoretical and Experimental Evaluation of Metal Hydride
Slurries as Materials for Hydrogen Heat Pumps

WHEREAS, the Department of Energy of the United States of America (hereinafter referred to as "DOE") and the Ministry of Energy and Infrastructure of Israel (hereinafter referred to as "MOEI") have entered into an Agreement in Energy Research and Development signed in Jerusalem, on June 3, 1984;

WHEREAS, DOE and MOEI (hereinafter referred to as the "Parties") recognize that it would be beneficial to both countries to work on a project using metal hydride slurries as materials for hydrogen heat pumps; (hereinafter referred to as "the Project");

WHEREAS, the Parties further recognize that the Project is of mutual interest to both countries;

Therefore, the Parties agree as follows:

ARTICLE 1

Scope

The goal of this project is to establish cooperation between U.S. and Israeli institutions, in order to advance the understanding in using metal hydride slurries in hydrogen heat pumps. The principal objectives are:

1. Study the sorption reaction of metal hydrides in the form of slurries.

2. Study heat and mass transfer problems associated with metal hydride slurries.

3. Design and build a reactor, measuring system, and a means for transferring slurries.

4. Perform measurements and document experimental and theoretical conclusions.

ARTICLE 2

The activities of this Annex shall be carried out under the following tasks:

TASK 1:

MOEI shall examine the feasibility of utilizing metal hydride slurries as reactive materials for hydrogen heat pumps and the like thermodynamic devices.

Ultimately, the performance of the heat pumps will be estimated in terms of specific thermal output power.

TASK 2:

MOEI shall examine methods for moving the slurries within the containers - heat-exchangers.

TASK 3:

MOEI shall examine the usefulness and practicability of cyclic separation of the hydrogen gas from the liquid and solid, within the circuit.

TASK 4:

MOEI shall design and build a circuit containing a reactor representing a modular element of a container heat exchanger. The circuit shall be connected to a diagnostic and data acquisition computerized system, in order to gather and evaluate data on heat transfer characteristics and kinetics associated with slurry hydriding and dehydriding reactions.

TASK 5:

MOEI shall consider hydride suspensions investigated at Brookhaven National Laboratory. This concept promises heat transfer improvements due to liquid-solid interface as opposed to gas-solid interface of conventional metal hydride pair heat pumps.

ARTICLE 3

The sorption of hydrogen by metal hydrides immersed in liquids is the subject of this investigation. The presence of a liquid within a container-heat exchanger may substantially facilitate the transfer of heat from the reactants to the external surfaces. However, whether this advantage makes metal hydride-liquid slurries appropriate for being used as reactive materials in hydrogen heat pumps (hhp), must still be investigated. It is the purpose of this research to study this application. The following schedule and milestones apply.

Schedule, Milestone and Reporting Requirements

Milestones:	Months from beginning
1. Study basics of the hydrogen sorption reaction of metal hydrides in the form of slurries.	0 - 10
Study heat and mass transfer problems associated with the hydrogen sorption of metal hydrides in the form of slurries.	
Study the separation of hydrogen gas from liquid and slurries if found desirable.	

2.	Design reactor, measuring system, and means for transferring slurries.	3 - 10
3.	Build the experimental system and start its operation and measurements.	6 - 12
	Contingent upon approval of U.S. DOE, for a second year:	
4.	Perform measurements	12 - 18
5.	Continue measurements, interpret results, derive experimental and theoretical conclusions.	18 - 24

Deliverables:

1. Continue cooperation and discuss results of the five tasks and status with Brookhaven National Laboratory.

2. First year report to DOE will include results of tasks one, two and three.

3. Second year final report will include results of tasks four and five.

ARTICLE 4

Administration

1. Overall responsibility for annual approval of the Project's technical content and budget shall rest with the Parties.

2. Each Party shall appoint a Project Leader for the detailed management of the Project. The Project Leaders shall be responsible to their respective Project coordinators (appointed pursuant to Article 3.3 of the Agreement dated June 3, 1984) for the working contacts between the Parties.

ARTICLE 5

Funding

1. The Department of Energy has agreed to fund MOEI for $45,000 in the first year for the work being done under the tasks. In addition, pending satisfactory completion of first year and availability of funding, DOE will fund MOEI $56,750 in the second year.

ARTICLE 6

Exchange of Personnel

1. Whenever an assignment of personnel is contemplated under this Annex, each Party shall ensure that qualified staff are selected for the assignment.

2. Each such assignment of personnel shall be the subject of a separate assignment arrangement between the Parties or between their contractors, subject in each case to the approval of DOE and MOEI.

3. Each Party shall be responsible for the salaries, insurance, travel, living expenses and other allowances to be paid to its assigned personnel, unless otherwise agreed in the separate assignment agreement.

4. The receiving Party shall assist in arranging for accommodations for assigned personnel and their families.

5. The receiving Party shall assist assigned personnel and their families as regards administrative formalities.

6. The assigned personnel shall conform to the general rules of work and safety regulations in force at the laboratory to which assigned, or as agreed in the separate assignment agreements.

7. Assigned personnel shall be given necessary assistance by the Receiving Party for the execution of their research and other activities under this Annex.

ARTICLE 7

Loan of Equipment

Each party agrees that in the event equipment is to be exchanged or supplied by one party to the other party, the following provisions shall apply covering the shipment and use of the equipment.

1. The sending party shall supply as soon as possible a detailed list of the equipment to be provided together with the associated specifications and technical and informational documentation.

2. The equipment, spare parts, and documentation supplied by the sending party shall remain the property of the sending party and shall be returned to the sending party upon completion of the mutually agreed-upon activity unless otherwise agreed upon.

3. The receiving party shall provide the necessary premises and shelter for the equipment, and shall provide for electric power, water, gas, etc., in accordance with technical requirements which shall be as mutually agreed upon.

4. Responsibility for expenses, safekeeping and insurance during the transport of the equipment from the original location in the country of the sending party to the place of entry in the country of the receiving party shall rest with the sending party. If the sending party elects to have the equipment returned, it shall be responsible for expenses, safekeeping and insurance en route from the place of entry in the country of the sending party to the final destination in the country of the sending party.

5. Responsibility for expenses, safekeeping and insurance during the transport of the equipment from the place of entry in the country of the receiving party to the final destination in the country of the receiving party shall rest with the receiving party. If the sending party elects to have the equipment returned, the receiving party shall be responsible for expenses, safekeeping and insurances en route from the place of departure in the country of the receiving party to the place of entry in the country of the sending party.

6. The equipment provided by the sending party for carrying out mutally agreed-upon activities shall be considered to be scientific, not having a commercial character.

ARTICLE 8

Information and Intellectual Property

1. The publication, distribution, handling, protection and ownership of information, and intellectual property, and rules and procedures related thereto, not covered by this Annex, shall be determined by the Parties by unaminity.

2. Subject to restrictions applying to patents and copyrights, the Parties shall have the right to use and disseminate all information provided to or arising from the Project. It is intended that the results of this Project shall be published in the scientific literature.

3. A Party possessing information arising in the course of or under this Project ("arising information") regarding inventions on which patent protection is to be obtained shall notify the other Party and thereafter such information shall not be published or publicly disclosed until a patent application has been filed, provided, however, that this restriction on publication or disclosure shall not extend beyond six months from the date of notice to the other Party under this paragraph. Such information shall be appropriately marked to restrict publication or disclosure.

4. Reports containing arising information and information developed prior to or outside the Project necessary for and used in the Project shall be exchanged by the Parties and will cover the work performed by each Party under this Project.

5. With respect to any invention or discovery made or conceived in this course of or under this Annex, DOE shall acquire all right, title, and interest in and to such invention in all countries, subject to a nonexclusive, irrevocable, royalty free license to MOEI, its Government, and its nationals designated by it."

6. Copyrights of either Party shall be accorded treatment consistent with internationally recognized standards of protection. Any material which

may be the subject of copyright developed under the Project may be copyrighted. A Party securing a copyright or rights thereto shall grant a royalty-free, non-exclusive license to the other Party to reproduce, publish, distribute, duplicate and use the copyrighted material.

7. Each Party shall, without prejudice to any right of inventors or authors under its national laws, take all necessary steps to provide the cooperation of its authors and inventors required to carry out the provisions of this Article 8. Each Party shall assume the responsibility to pay awards or compensation required to be paid to his employees according to the laws of this country.

8. It is not anticipated nor shall it be required that any exchange of proprietary information will occur under the activities specified under this Annex. Should a circumstance arise in which it is necessary or desirable to exchange proprietary information, then additional agreements will be developed.

ARTICLE 9

Other Agreements

The provisions of this Annex shall not affect the rights or duties of the Parties under other agreements or arrangements. This Annex also in no way precludes commercial firms or other legally constituted enterprises in each of the two countries from engaging in commercial dealings in accordance with the applicable laws of each country; nor does it preclude the Parties from engaging in activities with other governments or persons.

ARTICLE 10

Laws and Regulations

Activities under this Annex shall be in accordance with laws and regulations of the countries of the Parties. All questions related to this Annex shall be settled by the Parties by mutual agreement.

ARTICLE 11

Appropriated Funds

It is understood that the ability of the Parties to carry out their obligations under this Annex is subject to the availability of appropriated funds.

ARTICLE 12

Term

1. This Annex shall enter into force upon signature, shall continue in force for a two-year period, and may be amended or extended by mutual written agreement of the Parties.

2. In the event that, during the period of this Annex, the nature of either Party's energy programs should change substantially, either Party shall have the right to request revisions in the scope and/or terms of this Annex.

3. This Annex may be terminated at any time at the discretion of either Party, upon six months advance notification in writing by the Party seeking to terminate the Annex. Any such termination shall be without prejudice to the rights which have accrued under this Annex to either Party up to the date of such termination.

Done at Jerusalem this 17

day of November 1987.

For the Department of Energy
of the United States of America

For the Ministry of Energy
and Infrastructure of Israel