

Annex VI
To the Agreement between the Department
of Energy of the United States and the
Ministry of Energy and Infrastructure
of Israel in Energy Research and Development

Production of Alternative Fuels by Low-Temperature, Low-Pressure
Coal Conversion

WHEREAS, the Department of Energy of the United States (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 (hereinafter referred to as the "Agreement");

WHEREAS, DOE and MOEI (hereinafter referred to as the "Parties") recognize that it is beneficial to both countries to work on a project in Production of Alternative Fuels by Low-Temperature, Low-Pressure, Coal Conversion (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:

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Article 1Scope

The objective of the Project is to explore the intra- and extra-particle chemistry, mass transfer, and energy transfer during conversion of U.S. eastern high-sulfur bituminous coal in a split-stage, fluidized-bed reactor of innovative design. Low-pressure, low-temperature conditions will be employed and particular attention will be paid to sulfur chemistry. The acquisition of this data will allow comparison with similar data otherwise available on the same reactor when fueled by high-sulfur Israeli oil shale.

Article 2Task

Unless otherwise specifically stated herein, the MOEI shall provide the personnel, equipment, materials, and other items necessary to conduct the Project. The Project shall consist of the following six tasks:

Task 1 -- Materials Acquisition and Test Plan

MOEI shall obtain materials and equipment for the test plan described below. MOEI shall obtain the required equipment and materials for both the laboratory and bench-scale testing described below. DOE shall arrange for shipment to Israel of 1,000 kg of high-sulfur U.S. eastern bituminous coal.

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MOEI shall develop a test plan that shall detail the work to be accomplished in Tasks 2 - 6. The test plan shall include, in addition to other information required for a complete definition of the effort, the following information:

- Facility description, including instrumentation and analytical capabilities.
- Procedures.
- Test matrix and relationship to oil shale tests.
- Planned analysis of the solid, liquid, and gaseous products of the experiments, in particular liquids analyses.
- Planned evaluation of experimental results.
- Schedule for testing.
- Planned outline of final report.

The test plan shall be approved by both DOE and MOEI.

Task 2 -- Coal Evaluation: Laboratory-Scale Tests

MOEI shall characterize the U.S. bituminous coal; prepare graded samples for and conduct laboratory-scale tests; and compare data acquired with results available in the United States for the test coal. For the coal characterization, tests shall include, as a minimum, the following: ultimate analysis, sulfur types (organic/inorganic, aliphatic/aromatic), pyrolysis characteristics (proximate analysis, Fischer Assay, Roga Index), CaO and MgO in ash. The laboratory-scale tests shall use 20 mg sample sizes in 5 gm fluidized beds of

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inert material, and the particle size distribution shall go up to 2mm. Nitrogen and mixtures of air and nitrogen shall be used in separate tests and data shall be obtained at bed temperatures of 450o, 500o, 550o, and 600oC. Gas composition shall be measured by gas chromatograph to determine individual C₁-C₆ hydrocarbons, H₂S, CO₂, and CO. The amount and sulfur content of the liquid products and solids residue shall be determined for each test.

Task 3 -- Modification of Bench-Scale Reactor

Based upon the results of the lab-scale tests, MOEI shall design appropriate modifications to the split-stage reactor and install it. Maximum use shall be made of available auxiliaries. Anticipated changes required include modification of the solids interface chamber between the two stages and of the fluidizing gas distributor plates.

Task 4 -- Baseline Tests on Split-Stage Reactor

According to the approved test plan of Task 1, MOEI shall conduct a minimum of six baseline tests in the bench-scale, split-stage reactor without limestone addition. Exact base test conditions shall be established based on the result of Task 2. Values that shall not be varied in these tests are: (1) bed height: approximately 5 inches, (2) coal flow rate: approximately 7 kg/hour, (3) bed material: inert. Two coal particle size distributions shall be used. One graded feedstock shall have been single screened to below 2 mm in size. The other

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shall be a narrow size distribution below 2 mm. Pyrolysis temperature shall be varied and shall include a base temperature between 500° and 550°C plus two additional values. Gas flow rate (residence time) shall be varied and shall include a base value to be determined plus two additional values. Product measurements shall include as a minimum (1) gas chromatographic determination of individual C₁-C₆ hydrocarbons, H₂S, CO₂, and CO, (2) determination of liquids boiling point distribution and elemental analysis, and (3) determination for solids of proximate analysis and elemental analysis. Analysis of the data shall include comparison of results with those which would be expected from pyrolysis studies in the U.S. with the same coal.

Task 5 -- Split-Stage Reactor Tests with limestone Injection

MOEI shall conduct a second series of six tests according to the approved test plan of Task 1 with a limestone bed rather than inert material. Experimental conditions, data acquisition and analysis, and product analysis shall otherwise be comparable to those for the six tests of Task 4.

Task 6 -- Data Analysis and Final Report

MOEI shall submit a comprehensive final report to thoroughly document project performance and results. Elements from the test plan shall be updated and included as appropriate so that the Project shall be completely documented in a single report. Description of the bench-scale work shall include equipment, procedures, results, analysis of results,

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and calculation of design parameters for the split-stage reactor modifications. Description of the split-stage reactor testing shall include equipment, procedures, and results from both the inert-bed and limestone-bed tests. Data analysis shall include, as a minimum, mass balances, heat balances, product yields, sulfur balances, effect of temperature, effect of flow rate, and effect of limestone. When possible, mechanistic explanations shall be provided for observed variations in product composition/yields. Data shall be compared with that obtained otherwise with oil shale as the feedstock, and relationships between the two sets of data shall be defined.

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Article 3

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Schedule

MOEI shall develop and submit to DOE the test plan prepared under Task 1 within three months of the effective date of this Annex. The remaining tasks shall be completed as follows:

- Task 2 Within 6 months of the effective date of the Annex.
- Task 3 Within 8 months of the effective date of the Annex.
- Task 4 Within 11 months of the effective date of the Annex.
- Task 5 Within 13 months of the effective date of the Annex.
- Task 6 Within 15 months of the effective date of the Annex.

Article 4

Management

1. Overall responsibility for approval of the Project's technical content and budget, including approval of the test program, shall rest with the Parties.

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2. Each Party shall appoint a Project Leader for the detailed management of the Project. The Project Leaders shall be responsible to their respective Program and Technical Coordinator (appointed pursuant to Article 3.3 of the Agreement).

Article 5

Funding

1. The total cost estimated for this Project is \$160,000 U.S. dollars, with DOE providing a maximum aggregate sum of \$150,000 U.S. dollars.

2. The cost of meetings shall be borne by the Party that incurs them, and visits and assignments of personnel shall be borne by the Party sending the personnel in accordance with Article 2 of Annex I of the Agreement.

3. Payment Terms

a. Payment shall be made after the submission of proper invoices or vouchers for services rendered and accepted.

b. Payment for work or services under this agreement shall be due (30) calendar days after receipt of a proper invoice by the US DOE office designated in this agreement or (30) calendar days after acceptance of the work or services whichever is later.

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- c. Invoices shall be accompanied by a Statement of Costs which must be delineated by annex number or other segregation as designated within this agreement.
- d. An SF-1034 form will be used for billing purposes.
- e. An original and two copies of the invoice will be forwarded to the following designated payment office unless otherwise stipulated:

U.S. Department of Energy
Office of Procurement Operations
ATTN: MA-451.2
P.O. Box 2500
Washington, DC 20013-2500

Article 6

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 unanimity.
2. Subject to the 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,

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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 shall cover the work performed by each Party under this Project.

5. Inventions made or conceived in the course of or under this Project ("arising inventions") shall be owned by MOEI in Israel and by DOE in the United States and third countries. Each Party, its Government and the nationals of its country designated by it, shall receive a royalty-free, non-exclusive license in the countries where the invention is owned by the other Party.

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 this 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 co-operation of its authors and inventors required to carry out the provisions of this

Article 6. Each Party shall assume the responsibility to pay awards or compensation required to pay to its employees according to the laws of its country.

Article 7

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. Compensation for damages incurred during the implementation of this Annex shall be in accordance with the applicable laws of the countries of the Parties.

Article 8

Appropriated Funds

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

Article 9

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.

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2. In the event that, during the period of this Annex, the nature of either Party's energy program 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 _____ this _____ day
of _____, 1984.

Richard E. Harrington
Richard E. Harrington
For the Department of Energy
of the United States of America

R. M. M. M. M.
Jan Zorfast
For the Ministry of Energy
and Infrastructure of Israel

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