Oil Shale Technology

Final Report CRADA No. TC-0126-90-1

Date: March 1, 1995

TACT:

Revision:

A. Parties

The project is a relationship between the Lawrence Livermore National Laboratory (LLNL) and Amoco Corporation, Unocal Corporation and partners Chevron Shale Oil Company and Conoco Shale Oil, Inc..

University of California
Lawrence Livermore National Laboratory
7000 East Avenue
Livermore, CA 94550

Amoco Corporation
P.O. Box 3011, M/S E-26
Naperville, IL 60563-8408

Unocal Corporation
376 Valencia
Brea, CA 92621

Chevron Shale Oil Company
P.O. Box 599
Denver, CO 80201

B. Project Scope

This collaborative project with industrial participants studied oil shale retorting through an integrated program of fundamental research, mathematical model development and operation of a 4-tonne-per-day solid recirculation oil shale test unit. Quarterly, project personnel presented progress and findings to a Project Guidance Committee consisting of company representatives and DOE program management. We successfully operated the test unit, developed the oil shale process (OSP) mathematical model, evaluated technical plans for process scale up and determined economics for a successful small scale commercial deployment, producing premium motor fuel, specialty chemicals along with electricity co-production. In budget negotiations, DOE funding for this three year CRADA was terminated, 17 months prematurely, as of October 1993. Funds to restore the project and continue the partnership have not been secured.

C. Technical

Our technical progress stopped as of October 1993, due to termination of funding by DOE. No closeout funds were provided for project closeout or summary. Plans for process scale-up and field demonstration are currently on hold.

D. Partner Contribution

Our industrial partners provided technical know-how and guidance through quarterly meetings of the Project Guidance Committee. Due to the premature shutdown of the project, no further plans are progressing by industry for deployment of the technology.

E. Financial (\$K)

Federal	\$4407
Non-Federal	300
Total Funding	\$4703

MASTER

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	FY93	FY94	FY95	FY96	FYOUT	Total
LLNL Planned	4407	0	0	0	0	4407
Participant In-Kind	260	0	0	0	0	260
WAS Operating	4350	0	0	0	0	4350
Total Costs	4292	407	3	0	0	4702

F. Documents/Reference List

Reporting was in the form of informal presentations to the Project Guidance Committee. The project has retained these documents, which will be available for public distribution, five years after termination of this CRADA.

Final reports of the state of the technology were presented in the following:

R. J. Cena, "A Hot-Recycled-Solid Oil Shale Retorting Process for the Production of Shale Oil and Specialty Chemicals", Preprint: American Chemical Society, Division of Fuel Chemistry, Vol 39, No. 4, pp 1248-1252, 208th ACS National Meeting, Washington D.C, August 20-25, 1994.

R. J. Cena, " Status of LLNL Hot-Recycled Oil Shale Retort, Proceedings of the Fuels Technology Contractors Review Meeting, U.S. Department of Energy Report DOE/METC-94/1102 (DE94004065), November, 1993, pp. 17-27.

T. T. Coburn et al, "Shale Oil from the LLNL Pilot Retort: Metal Ions as Markers for Water and Dust," Proceedings of the Fuels Technology Contractors Review Meeting, U.S. Department of Energy Report DOE/METC-94/1102 (DE94004065), November, 1993, pp. 28-36.

G. Property and Proprietary Information:

All property is owned and remains with the DOE. Proprietary information supplied by the companies has been destroyed.

H. Acknowledgment

Participant's signature of the final report indicates the following:

- 1) The Participant has reviewed the the final report and concurs with the statements made therein.
- 2) The Participant agrees that any modifications or changes from the initial proposal were discussed and agreed to during the term of the project.
- 3) The Participant certifies that all reports, inventions disclosures and patent applications attributable to the project are completed or are in process and a list is attached to this report.

P.C. Lingle 10/30/95
[Industrial Participant] Date
Ameco Corporation

Robert J. Cerna 1/8/96
[LLNL Principal Investigator] Date

Carl D. McAulay 11/14/95
[Industrial Participant] Date
Unocal Corporation

J. E. Bishop 12/14/95
[Industrial Participant] Date
CHELSEA SHALE OIL CO.

Attachment I - Accomplishments Summary

Oil Shale Technology

Project Accomplishments Summary (Attachment I) CRADA No. TC-0126-90-1

Date: March 1, 1995

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A. Parties

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Denver, CO 80201

B. Background

Work on oil shale technology at LLNL has been underway for a number of years. Recent DOE funding has been provided to advance the work toward commercial application based upon the anticipated involvement of several oil companies that have extensive experience in the recovery of oil from shale.

C. Description

The objective of the project was to advance the development of oil shale retorting technology. This collaborative project with industrial participants studied oil shale retorting through an integrated program of fundamental research, mathematical model development and operation of a 4-tonne-per-day solid recirculation oil shale test unit. Quarterly, project personnel presented progress and findings to a Project Guidance Committee consisting of company representatives and DOE program management. We successfully operated the test unit, developed the oil shale process (OSP) mathematical model, evaluated technical plans for process scale-up and determined economics for a successful small scale commercial deployment, producing premium motor fuel, specialty chemicals and electricity for on-site use and off-site sale. We received valuable insights from our interactions with industry and jointly we developed process economics for a commercial-scale deployment which would provide a fifteen percent rate of return on investment in 1994 dollars. The project was prematurely terminated by vote of Congress as of October 1993. However, research prior to that time shows that the technology is ready for a field demonstration at the 100-300 barrel-per-day scale. We are seeking DOE funding for this scale-up.

D. Expected Economic Impact

The shale basins in the Western United States contains the largest and richest oil shale deposits known, with estimated recoverable oil exceeding 600 billion barrels, which rivals the proven petroleum reserves of the Persian Gulf. Development of an oil shale industry could provide an abundant source of liquid fuels for a very long time. Development of an economic and environmentally acceptable oil shale retorting process could begin the development of a major new domestic industry with revenues in the trillions of dollars. Development of an oil shale industry would benefit consumers by providing a domestic source of liquid transportation fuel, independent from foreign controlled supplies. Taxpayers would benefit from the revenues and salaries

generated, as well as from royalties and other land use fees associated with development of this primarily Government owned land.

E. Benefits to DOE

Fossil energy development is core to the DOE mission. The US transportation infrastructure depends almost entirely on liquid motor fuels of which only 50 percent comes from domestic supplies. Development of domestic oil shale industry could provide enough motor fuel to supply current US demand for the next 160 years. Development of this industry would limit US dependence on imported oil and would keep to a minimum the price of US consumers paid for imported oil.

F. Industry Area

Development of a successful oil shale industry would provide domestic supplies of high quality motor and jet fuel products, specialty chemicals and electricity. This would directly benefit the petroleum, refinery and specialty chemical industries. Development of the industry would benefit the construction and mining industry. One specialty product, an asphalt additive to extend the life of highways, would benefit the highway construction industry. Other specialty chemical, including waxes and perfumes, would provide products for domestic and export markets.

G. LLNL Point of Contact for Project Information

Robert J. Cena
Lawrence Livermore National Laboratory
7000 East Avenue, L-365
Livermore CA 94550
(Phone: 510-422-7336)
(FAX: 510-423-4289)

H. Company Size and Point(s) of Contact

Robert D. Hall, Amoco, (708) 717-2433
Gary E. Bishop, (Chevron-Conoco), (303) 930-3103
Carl D. McAuley, Unocal, (714) 528-7201

I. Project Examples

See Brochure - Advanced Technology for Recovering Oil From Shale, DOE/FE-0270P

J. Release of Information

Robert J. Cena
Oil Shale Project Leader
Chemistry and Materials Science Department
(Phone: 510-422-7336)
(FAX: 510-423-4289)

RELEASE OF INFORMATION

I have reviewed the attached Project Accomplishment Summary prepared by Lawrence Livermore National Laboratory and agree that the information about our CRADA may be released for external distribution.

P.E. Lough 10/30/95
Name Date
Organization Amoco Corporation
Title Director, Solid Resources

Carl D. McAulay 11/14/95
Name Date
Organization Unocal Corporation
Title Manager, Staffing + Recruiting

A. Busby 12/14/95
Name Date
Organization Chevron Service Oil Co
Title Manager