

ACCELERATED OIL SHALE  
IN SITU RESEARCH

A Proposal for Acceleration  
of the In Situ Oil Shale  
Gasification Program

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January 1976

Prepared by  
Energy Research and Development Administration  
Laramie Energy Research Center  
A. W. Decora, Director

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February 6, 1976

Dr. Philip C. White, Assistant Administrator for Fossil Energy, HQ

PROPOSAL FOR UTILIZATION OF ERDA FACILITIES AT ANVIL POINTS FOR  
ACCELERATION OF LERC IN SITU OIL SHALE GASIFICATION PROGRAM

The ERDA facilities at Anvil Points, Colorado are leased to Development Engineering, Inc., for research on the Paraho process. The original 30-month lease is nearing an end. With the turn-down of this oil shale demonstration program, we have been examining ways in which the facilities and the technical crew presently employed by DEI might be useful to the ERDA Oil Shale Program.

I have asked Harry Carpenter and Ed Burwell, who are conducting the LERC Program in In Situ Oil Shale Gasification, to critically examine the possibility of effecting an acceleration of that program by utilization of Paraho facilities and work force. Our study, which is attached, indicates potential savings of considerable Federal monies and a compression in the time schedule for our program through such utilization. These significant savings are estimated to amount to \$5.3 million to accelerate the research by approximately 2 years. Details of the analysis are given in the attached report.

In order to take advantage of the utilization of these facilities and to secure the acceleration of the program and the net dollar savings, we must act with haste because of the imminent closure of the Paraho operation, scheduled for last April or early May of this year. I request funds totalling \$1.308 million through August of 1976 in order to conduct the program as described in the attached document. We believe that there is sufficient uniqueness to the Paraho Project to allow sole source procurement.

We will be pleased to supply additional information upon your telephone call or letter. We hope that you will act favorably on our request.

Andrew W. Decora  
Director

Enclosure

## ACCELERATED OIL SHALE

### IN SITU RESEARCH

#### SYNOPSIS

It is proposed that the Paraho Oil Shale Demonstration Project, located at the Anvil Points facility near Rifle, Colorado, be contracted by ERDA to accelerate investigation of process variables as part of the oil shale gasification program of the Laramie Energy Research Center. These process variables are concerned with optimizing the quality and quantity of gas and liquid products obtained from retorting oil shale. The total funding requested for the proposed contract program is \$1.308 million for a 7-month program of work. The surface oil-shale retorting facilities at Anvil Points can be efficiently and economically utilized in LERC's present 5-year program to effect an estimated \$5.3 million savings in total program cost and an acceleration of the research program by at least 2 years.

#### LERC OIL-SHALE GASIFICATION PROGRAM

Research leading to development of an in situ retorting process emphasizing gasification is in progress at LERC. This research has the following objectives: (1) To produce sufficient energy in an offgas stream to operate the process, (2) to study the feasibility of producing a supply of 600+ Btu/ft<sup>3</sup> gas, (3) to define the operating parameters for operation of the in situ process to ensure maximum utilization of the resource in an environmentally acceptable manner. To conduct this research, the U. S. Energy Research and Development Administration FY 1976 budget includes In Situ Processing Subprogram funds for gasification research. It was stated in this budget that the increased funding will be used to extend the present laboratory

research on in situ gasification to a pilot scale, using equipment in which underground conditions can be simulated to define the effects of operating variables and to provide a general basis for estimating process operability and costs under actual conditions. In the program, design of the pilot facility is scheduled to be contracted in FY 1976. Construction and shake-down operations, also scheduled to be contracted, are projected for the following year. Depending on progress and results, the ultimate goal is to conduct an actual field demonstration of the process starting about FY 1979.

The current research at LERC has demonstrated that control of process variables allows usable gas to be produced concurrent with higher quality shale oil. LERC research on western oil shales is directed at determination of process variables directed toward producing desired mixtures of gas and oil during retorting. Bench-scale retort work to develop statistical models relating operating parameters to products has been underway for over 2 years at LERC. An intermediate scale (0.5-ton batch) gasification retort will be in operation in early calendar year 1976 to verify the models.

The next phase of the research program schedules construction of a pilot plant (21-ton) gasification retort to be designed under contract to continue scale-up of the oil-shale gasification work. The proposed research schedule would require total estimated funding of \$26.2 million and be completed in 1980.<sup>1</sup>

This design for the 21-ton batch gasifier will be a "turnkey" operation. The request was scheduled to be for an industrial group to build, instrument, and operate the pilot unit. Laramie Energy Research Center personnel were to define the operating parameters, to be actively involved in all phases of the construction and operation, were to retain responsibility

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<sup>1</sup> The proposed funding levels by year are listed in table 1.

for research direction, and were to be responsible for workup of all data. The plant was to be physically located near the Laramie Energy Research Center to allow efficient use of existing facilities and personnel. It was planned to set up a research site where planned laboratory work, small-scale gasifier, and the 21-ton aboveground pilot unit could share personnel, physical facilities, and control instrumentation. The purpose of this pilot unit is to develop the operating parameters necessary for later field operation; so included as appendant research studies are gas cleanup equipment and equipment to study efficient usage of the offgas.

#### ACCELERATION OF PROGRAM

The current research being conducted at the Paraho Oil Shale Demonstration Project is scheduled for completion by April 1976. This makes the facilities available for other research, and the engineering staff at LERC has considered the use of the facilities to accelerate the authorized oil shale gasification program.

Since the Paraho facility (ERDA property) is already built, in operation, and staffed by DEI personnel, approximately 2 years could be saved in the research program if the LERC research program could contract DEI to conduct planned experiments. Consultations between the Paraho operators and LERC engineers indicate that the present facility, with some modifications, could perform much of the research planned for LERC's proposed pilot plant. Many advantages could be realized:

1. A 2-year acceleration of the oil shale gasification research program.
2. Cost savings of over \$5 million.
3. Continued operation of mine to supply oil shale for other research projects.

4. Immediate availability of a trained oil shale research group.
5. Opportunity to obtain environmental impact data.

Environmental program objectives for assessing aboveground retorting operations can be fulfilled with this proposed program of research utilizing the Paraho facilities. The details of an environmental research program will be planned jointly with the process research. In the past, the Paraho operating conditions were variable. This type of research proposed for gasification will provide the first opportunity to address the concerns associated with a particular processing scheme.

Table 1 shows both the currently proposed funding and the funding of the program if accelerated by use of the Paraho facility. Major changes shown in the table are the need for \$1.8 million additional money in FY 1976 and deletion of construction cost for a large-scale pilot plant at LERC.

TABLE 1. - Funding options, MM dollars

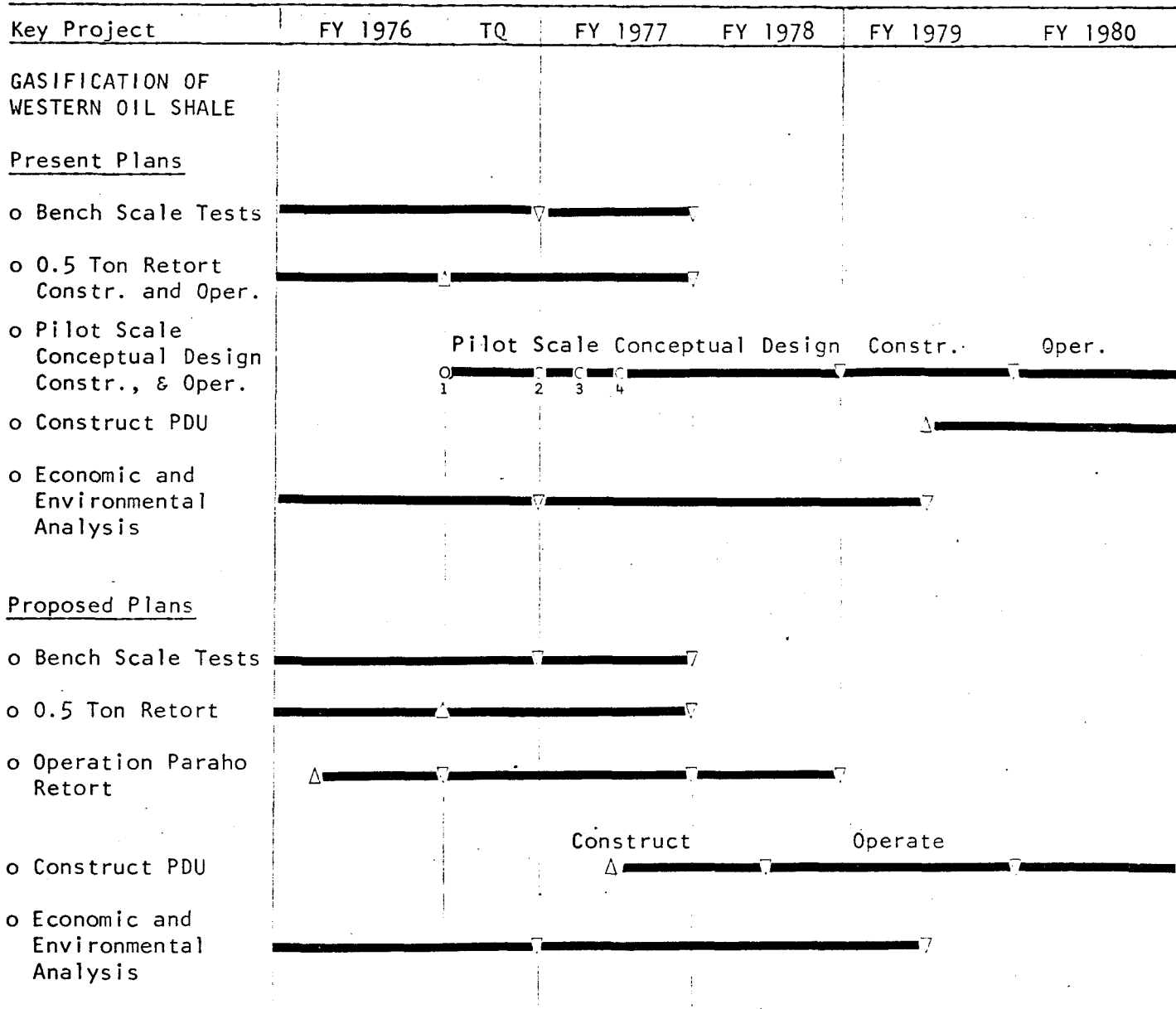
Option <sup>1</sup>	1976	TQ	1977	1978	1979	1980	Total
A	0.6	0.1	10.1	5.1	3.1	7.2	26.2
B	2.4	0.8	3.5	4.5	6.2	3.5	20.9

Savings: 5.3

- <sup>1</sup> A. As currently proposed.  
B. Proposed acceleration.

Figure 1 is an overview of the oil shale gasification program milestones. The top part of the figure indicates key projects under the present plans while the bottom part of the figure indicates key projects under the proposed accelerated action. The significance of the proposed plans is reflected by the replacement of the pilot-scale unit with the Paraho retorts which eliminates the time required to select contractors, design, and build a pilot unit and the start time of the field PDU approximately 2 years earlier than under present plans.

FIGURE 1. - Oil-Shale Gasification



- Legend
- △ Begin milestone
  - 02 Proposals received
  - ▽ Completed milestone
  - 03 Contractors selected
  - Σ Decision milestone
  - 04 Contract awarded
  - 01 Release RFP or PON
  - 05 Final EIS
  - 06 Process evaluation

The proposed program, as defined by LERC, consists of four phases designed to verify laboratory data that improve the quality and quantity of gas and liquid products from the oil shale retorting operation by the addition of oxygen, carbon dioxide, and water to the retort recycle gas streams. This program is scheduled to phase with the shutdown of the present Paraho Oil Shale Demonstration Project. This schedule makes it possible to effectively utilize experienced key employees presently scheduled to be released by DEI, for the LERC program.

Details of the four phases are presented in the next pages and consist of the following:

- Phase I - Preparation for operation
- Phase II - Shakedown and exploratory operations
- Phase III - Variable studies
- Phase IV - Confirmation of variable studies, simulate production operations, and report results of the program

The milestone chart for the phases are shown in figure 2 except for Phases III and IV which can best be defined after exploratory tests have been conducted. Detailed funding for Phases I and II are shown in table 2. A listing of tasks under each phase follows:

#### PHASE I

Task: Preparation for Operation

- A. Design revisions to existing Paraho retort system.
- B. Procure the equipment required for the retort changes.
- C. Reopen the mine.
- D. Make the changes and refurbish the existing equipment and facilities required for the Phase II operations.
- E. Finalize the operating program and the data reduction and analysis procedures for Phase II of the program.
- F. Instruct personnel in the operation of the revised facilities.

FIGURE 2. - Milestones for Oil Shale Retort Gas-Oil Optimization Program

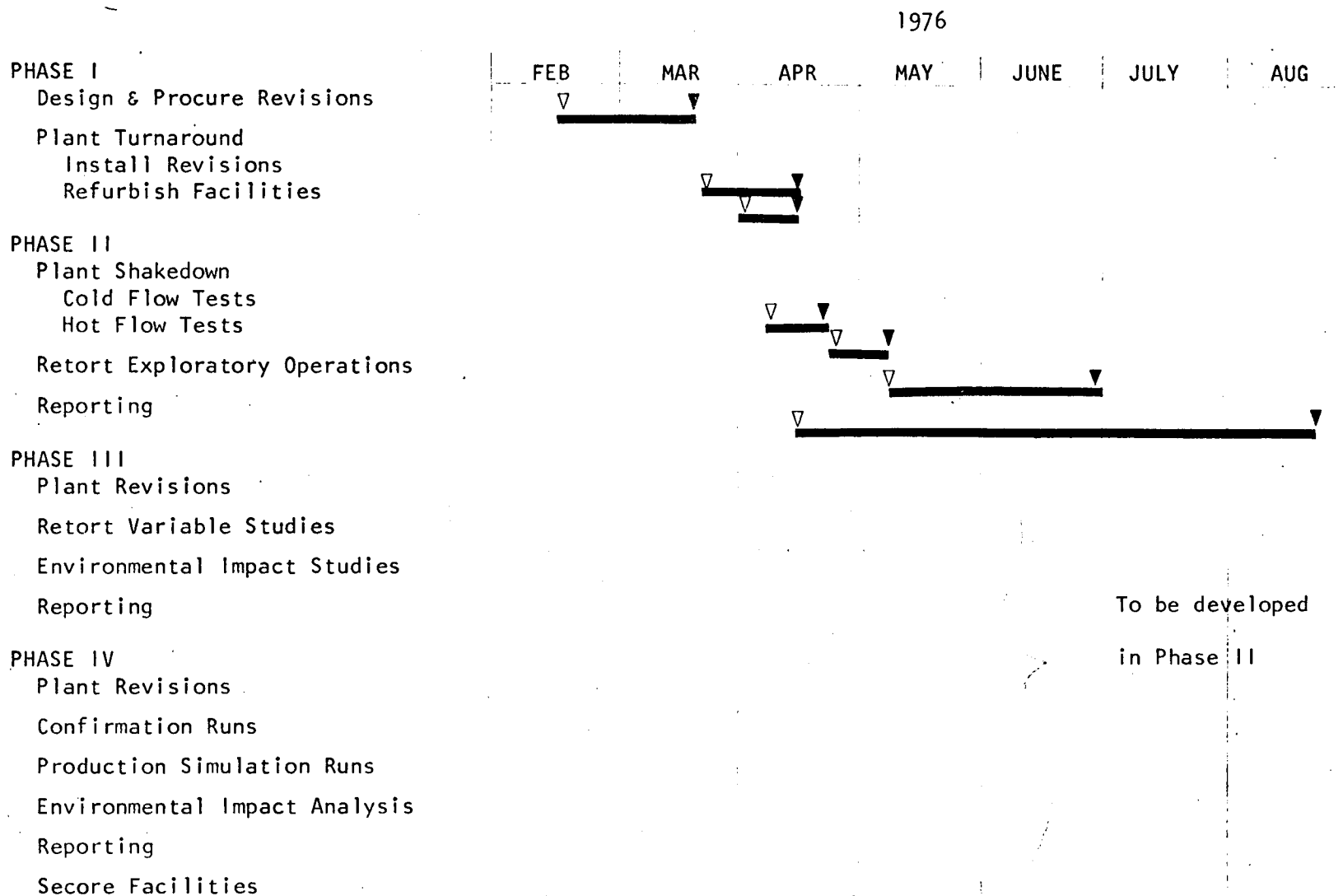


TABLE 2  
EXPENDITURE SCHEDULE  
PHASES I & II  
PARAHO OIL SHALE RETORT  
GAS-OIL OPTIMIZATION PROGRAM

	<u>Monthly</u>	<u>Cumulative</u>
February	86,000	86,000
March	196,000	282,000
April	271,000	553,000
May	230,000	763,000
June	274,000	1,057,000
July	138,000	1,195,000
August	113,000	1,308,000

## PHASE II

Task: Exploratory operations, using bottled gases, to determine the magnitude of the effects of addition of oxygen, carbon dioxide, and water on the retort operation and on the products of retorting.

### A. Equipment shakedown

1. Operate all the equipment under simulated retorting conditions to test the performance and train the personnel in the operation of the revised facilities.
2. Operate the facilities at low retorting rates to determine control characteristics.

### B. Crush the shale as needed for the retorting operation.

### C. Retort exploratory runs.

Operate the retort, making controlled addition of the following to the retort recycle gas streams:

1. Oxygen
2. Carbon dioxide
3. Water
4. Mixtures of oxygen, carbon dioxide, and water

## PHASE III

Task: Investigate and select the process variables and level of operation having the optimum impact on the technological and economic feasibility for production of gas and liquid products from oil shale.

### A. Revise and condition the facilities to conform to the findings found in Phase II to expedite and minimize the cost of the operation and collection of data from these variable studies.

### B. Determine effects of controlled inputs of:

1. Oxygen
2. Carbon dioxide
3. Water
4. Mixtures of oxygen, carbon dioxide, and water

### C. Determine the effects of the parameters listed in "B" above, on:

1. Shale mass rates

2. Shale grades
  3. Shale particle size ranges
  4. Retort bed heights
  5. Distributor spacing and design
  6. Product gas/oil mist retort withdrawal designs
- D. Monitor operations and determine the environmental impact of the retort variables on:
1. Air quality
  2. Retorted shale characteristics
  3. Surface water quality
- E. Analyze, report the data, and prepare the program and cost estimate for Phase IV

#### PHASE IV

Task: Confirmation runs to verify the findings of Phase III and report the project results.

- A. Revise and condition the facilities as needed to conduct the work programmed for Phase IV
- B. Operations
1. Verify the findings of Phase III
  2. Make extended runs to simulate production operations and to define retort operability and process repeatability and to select the design parameters, corrosion and wear factors to use in the design and scaleup
- C. Prepare project report containing the data collected and evaluations of the effect of the different variables on:
1. Quality and quantity of gas and liquid products
  2. Impact on the environment
  3. Technical and economic feasibility of this mode of retorting on the recovery of the Btu values from oil shale

#### SUMMARY

Utilization of the Paraho Oil-Shale Demonstration Project personnel and ERDA facilities at Anvil Points, Colorado, under a contract to LERC to

perform planned oil-shale gasification research is proposed. This utilization has potential for saving an estimated \$5.3 million and compressing the time schedule by at least 2 years for the gasification program. An immediate need for \$1.308 million is required to implement the program.