COLORADO TRACT C-b DEMONSTRATION PROJECT STATUS AND PLANS

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ABSTRACT

A demonstration project proposed by Occidental Oil Shale, Inc., (OOSI) at Colorado Tract C-b has advanced into the final planning and engineering phase. A comprehensive plan and justification for this proof-of-concept oil shale facility will be completed in the next few months. This "Plan," which is jointly sponsored by state and local governments of Colorado, the U.S. Department of Energy, and OOSI, includes an in-depth investigation into the economics, financing alternatives, marketing of products and electrical power, environmental considerations and technologies to be employed. The project involves OOSI's Modified-In-Situ (MIS) retorting and a Circulating Fluidized Bed Combustor (CFBC) for producing electrical power and steam, for internal use and external sale, from MIS gas, oil shale and coal. The site is also available for surface retorting technology demonstrations by third parties.

The next step in the project is to complete the final design. Following review and approval by the participants, procurement and construction of the facility will be initiated, subject to funding authorization and availability. Operations are contemplated to produce 1206 barrels per day of shale oil and 43 mega-watts of electrical power for several years to obtain scale-up information and operating confidence to proceed with a commercial plant when economics conditions warrant.

BACKGROUND

During the past 70 years, billions of dollars have been spent in pursuit of Western United States oil shale commercialization. Efforts have been cyclical because of swings in world oil prices and prevailing political views. However, the immense size of the western oil shale resource, estimated at one thousand (1,000) billions barrels of recoverable reserves, continues to stimulate national interest.

During the late 1970's and 1980's in response to disruptions in foreign oil supplies and high prices and stimulated by U.S. federal government incentives, a number of major firms prepared to build commercial-scale demonstration oil shale projects. They proposed to use existing technologies, which hindsight has proven were not technically ready for scaling-up to 10,000 barrel per day modules. Only the Union B technology was ultimately constructed and, as of this date some six (6) years after start-up, has achieved about 70% of rated output.

Therefore, industry is left with limited technology options for responding to the need to commercialize production from Western United States oil shales. A logical response to this dilemma is to conduct engineering-scale proof-of-concept demonstrations to provide technologies that are ready for commercialization after the year 2000.

Occidental Oil Shale has been active in the development of oil shale for nearly 20 years. A versatile technology was developed that is uniquely suited to the oil shale deposits of the Western United States. This process is known as Modified-In-Situ (MIS) processing because a large portion of the shale is left in place and retorted in the ground. Occidental spent over $300 million on the development of MIS as well as on resource acquisition, environmental monitoring, engineering studies and socio/economic mitigation measures. Private industry as a whole has spent over $3 billion on oil shale projects in the West over the last 15 years.

In the 1970's and 80's Occidental and its partners conducted programs that verified the technical viability of the MIS technology. During this period a number of commercial design scenarios were developed for Tract C-b and some $350 million was spent in developing infrastructure at the Tract. More recently, engineering studies were completed on the use of a CFBC to produce electric power and steam for internal use and sale.

We have, in the United States, a plan for determining the most reasonable cost of shale oil and for considering other problems ascribed to its development. At the urging of the Associated Governments of Northwest Colorado in 1986, the Oil Shale Action Committee was formed as a coalition of interested individuals, industrial companies and state and local government officials in Utah, Wyoming, and Colorado. This coalition urged the Congress to appropriate funds in FY 90 for the design, construction and operation of a proof-of-concept facility in the West. Occidental has joined this coalition and has offered the use of its Tract C-b as a site for the facility. The C-b site was one of the six tracts included in the Department of Interior's (DOI) Prototype Oil Shale Lease Program.

The U.S. Congress did appropriate $750,000 for FY 90 to support the development of a comprehensive plan and justification for a proposed oil shale facility involving insitu processing of western shales as well as possible surface processing of mined materials and wastes.

In response to this appropriation, Occidental Oil Shale, Inc. (OOSI) submitted an unsolicited proposal to the DOE in December. Included in the proposal is a commitment from the State of Colorado and Rio Blanco County to contribute a combined $400,000 toward the effort. OOSI has pledged to match the State and Federal Governments' contribution so that the total cost of the proposed work will be a minimum of $2.3 million.

The DOE accepted OOSI's proposal in January, 1990, and work on the Plan and Justification for the facility (the Plan) is underway.

PROPOSED DEMONSTRATION PROJECT

The proof-of-concept oil shale facility planned for Tract C-b will employ Occidental's MIS technology to produce 1206 barrels per day of raw shale oil (Figure 1). Oil shale mined to create voids for MIS retorts will be combusted along with MIS gas and coal in a CFBC. The alkali material in the oil shale will serve as the sulfur sorbent. The steam generated by the CFBC will be used to produce 43 megawatts of electrical power, some of which would be used internally and the rest sold.

MIS technology was developed to take advantage of the unique features of thick, deep deposits. It is a technology that processes much of the oil shale in place, thereby avoiding considerable mining and materials handling expense.

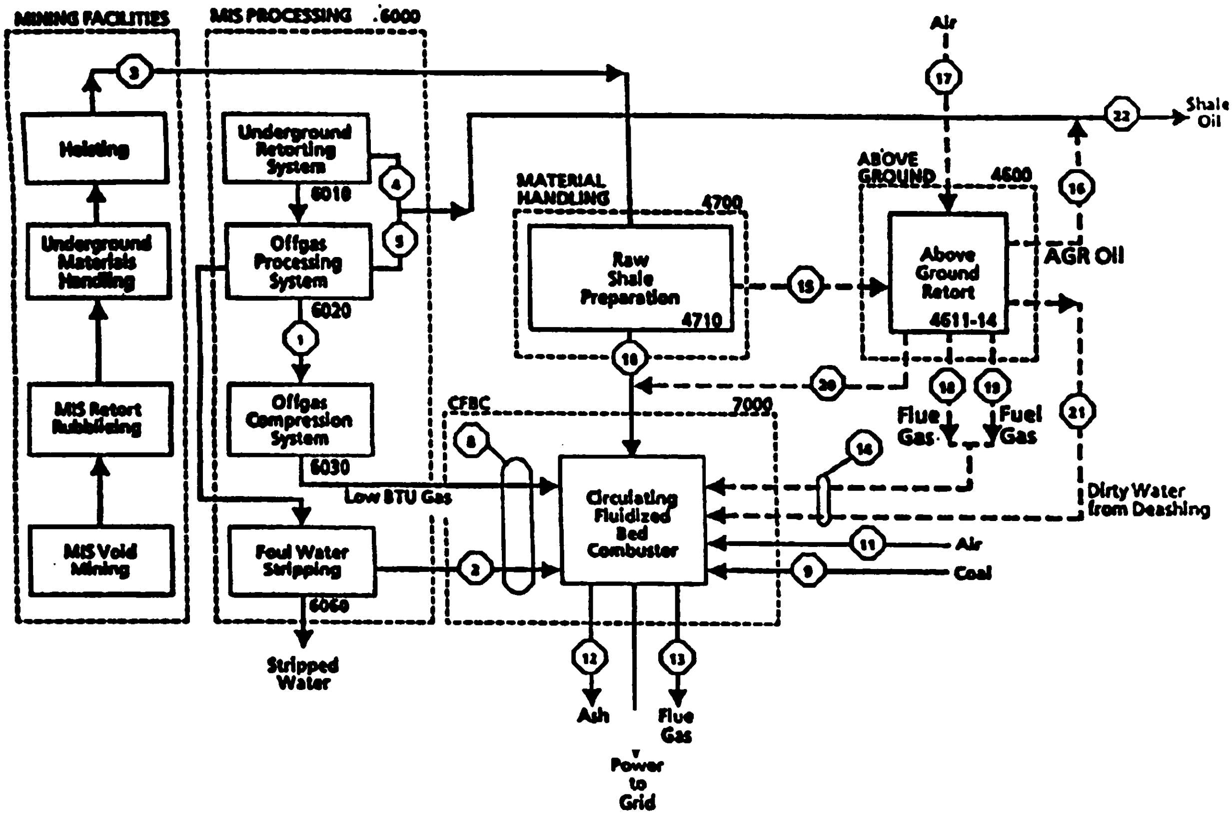

Figure 1. Block Flow Diagram

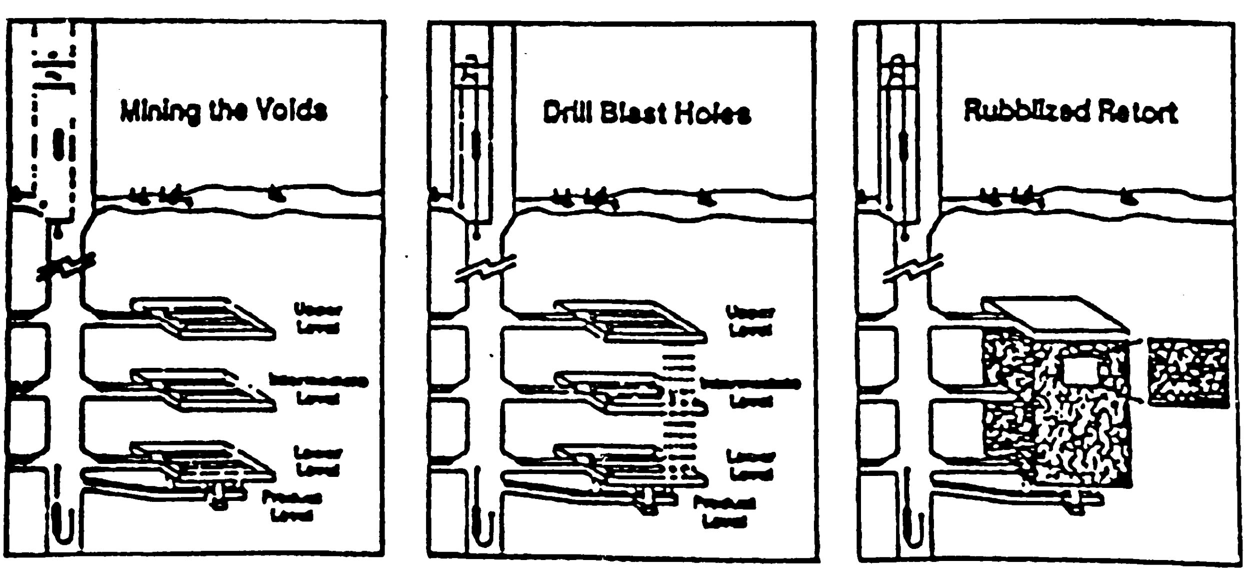

Figure 2. Construction of MIS Retorts

Underground rooms are constructed by standard room and pillar mining techniques, three such rooms being located at various elevations above each other (Figure 2). Holes are drilled, in prescribed patterns, into the remaining rock separating and supporting these rooms. These holes are then filled with chemical explosives in proprietary amounts and locations. The explosives are detonated in preset patterns creating an underground rubble mass, containing 350,000 tons of broken oil shale, and an open or void volume amounting to 20% of the resulting chamber or retort.

The openings to the drifts are then closed off with steel bulkheads containing suitable openings for piping to allow product gases and oil to be withdrawn. The top of the retort is then heated to ignition temperature with hot gases. The gases are drawn downward through the retort by blowers on the surface, which maintain a suction on the retort bottom. Air is next introduced, causing some of the carbon on the heated shale residue (spent shale) to burn, driving a thermal front downward through the retort. This releases the kerogen as hydrocarbons, which then flow to the bottom of the retort where the heavier ones are collected as liquids and the lighter ones exit with the exhaust gases, and are removed at the surface. Recoveries of about 70-80% are expected. When the retorts have been so processed, water is poured over them to cool and clean the spent shale. New retorts will be prepared and processed on a schedule compatible with the desired production rate.

Although an above ground retort (AGR) is not specifically included in this Plan, Occidental welcomes AGR developers to conduct testing at Tract C-b, subject to suitable business terms.

The proof-of-concept oil shale facility is estimated to cost $225 million in initial capital (Figure 3) and incur annual operating costs of $30 million (Figure 4). Revenues from the sale of shale oil and electricity are estimated at $24 million per year. The project is expected to last 10 years. Final design and construction is estimated to require 3-years followed by 7-years of startup and operations.

	$MILLION
Mine	$ 27.0
MIS Facilities	27.6
Buildings	13.8
Site Prep	5.8
Shale Handling	4.0
CFBC Power Generation	52.3
Support Facilities	19.6
TOTAL DIRECT FIELD COSTS	150.1
Indirects and Field Costs	57.8
Other Owner Costs	17.2
TOTAL PROJECT COST	$225.1

Figure 3. Project Capital Costs

		$000/year
Natural Gas	$2.00/MMBTU	$ 193
Coal	$1.25/MMBTU	2,102
Electrical Power	$0.05/KWH	0
Diesel Fuel	$1.25/gal	85
Operating Supplies		29
Operating Labor		5,120
Maintenance		4,019
Ash Disposal		27
Retort Construction		4,708
Mining		5,920
Unallocated Support		7,861
TOTAL ANNUAL COST		$ 30,064

Figure 4. Project Operating Cost

PLAN AND JUSTIFICATION PROGRAM

Results to date indicate that a demonstration project is the next logical step in developing technology for commercializing western U.S. oil shale. Earlier programs fostered by the Synthetic Fuels Corporation (SFC) proposed to achieve production goals that required unrealistically high scale-up factors. What is needed now is a program which provides demonstrated technologies that can be employed confidently in the next decade when petroleum supply/demand projections indicate the U.S. will need leverage to function as a prudent buyer of foreign oil.

The development of the Plan officially began in 1990. However earlier work conducted by OOSI and DOE provides extensive background for the planning of a proof-of-concept oil shale facility.

The major activities included in the development of the Plan include:

- Engineering, design and cost estimate
- CFBC design confirmation
- Permit reactivation
- Shaft facility review
- Mine plan finalization
- Tract C-b lease requirements
- Financial plan development
- Marketing plan development
- Management plan development
- QA/QC plan finalization
- Environmental analysis
- Reports

The conduct of the above activities will result in two reports; a Project Assessment Report to be completed by June 1, 1990 and a Final Report scheduled for completion September 30, 1990. More importantly the information developed will provide the basis for moving the Project into the final design, procurement and construction phase.

The team assembled to develop the Plan includes Bechtel, Houston; Ford, Bacon and Davis, Bunger & Associates, Geokinetics, and the University of Utah, Salt Lake City; Agapito and Associates, EMRx and Parsons-Brinkerhoff, Grand Junction; Western Research Institute, Laramie; University of West Virginia, Morgantown; and Boston Pacific, Washington, DC. Other contractors may be added as needed.

Following the successful completion of the Plan, the commencement of final design activities will begin, subject to funding availability and approval by the participants, and field construction and mining for the Project can be initiated as early as 1991. The $350 million spent on the Tract, make this early project start possible and also facilitates the commencement of a commercial project at the conclusion of the demonstration program. The reserves on Tract C-b are estimated at 4.5 billion barrels.

COMMERCIAL PROSPECTS

The commercial project that would emerge from a successful demonstration at Tract C-b would be much smaller than projects envisioned during the SFC era, in recognition of the technical, environmental and financial difficulties encountered in technology commercialization. Last year, in conjunction with DOE, Lawrence Livermore National Laboratory (LLNL) and Western Research Institute (WRI), an estimate was prepared by Bechtel for a commercial project selling 23,000 barrels per day of a syncrude and 43 megawatts of electricity. The project employs MIS, AGR and CFBC technologies. Its capital requirement is $1,160 million. Operating costs averaged $21 per barrel. Based upon a 20% DCF rate of return and reasonable financial assumptions, the project would be profitable at a $30 per barrel syncrude price. Many economists believe such a price is probable in the 2000-2010 era. More importantly, as the finite reserves of petroleum dwindle in the next century, shale oil will undoubtedly become more economic. Add to this rationale the fact that production of shale oil from a plant does not decline over time as it does from an oil reservoir and only the operating cost component is subject to inflation.

SUMMARY

A proof-of-concept demonstration at Tract C-b has the potential to make a significant contribution to the Department of Energy's Fossil Energy Program by developing technologies that can determine the value of western oil shales in reducing the nations dependence on foreign petroleum. The United States has the largest oil shale deposits in the world, estimated to contain over 1000-billion barrels of recoverable oil. The majority of this oil is found in the thick, deep seams of the West which are accessible primarily by underground mines which are wet and gassy. These deposits can be recovered most economically and efficiently when MIS processing is combined with above ground retorting. It is estimated that such combined processing can produce upgraded shale oil for less than $30/barrel. Unocal is developing AGR technology on a commercial scale at their Parachute Creek facility. Comparable development of MIS technology is needed to realize the $30/barrel projected commercial economics.

An engineering demonstration of MIS, and other technologies, is the logical next step. Tract C-b is the ideal site because the infrastructure and permit status facilitate an early start at lower than "green field site" costs. In order to be successful the project must have consensus, active participation of federal, state and local government and a strong industrial sponsor.

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