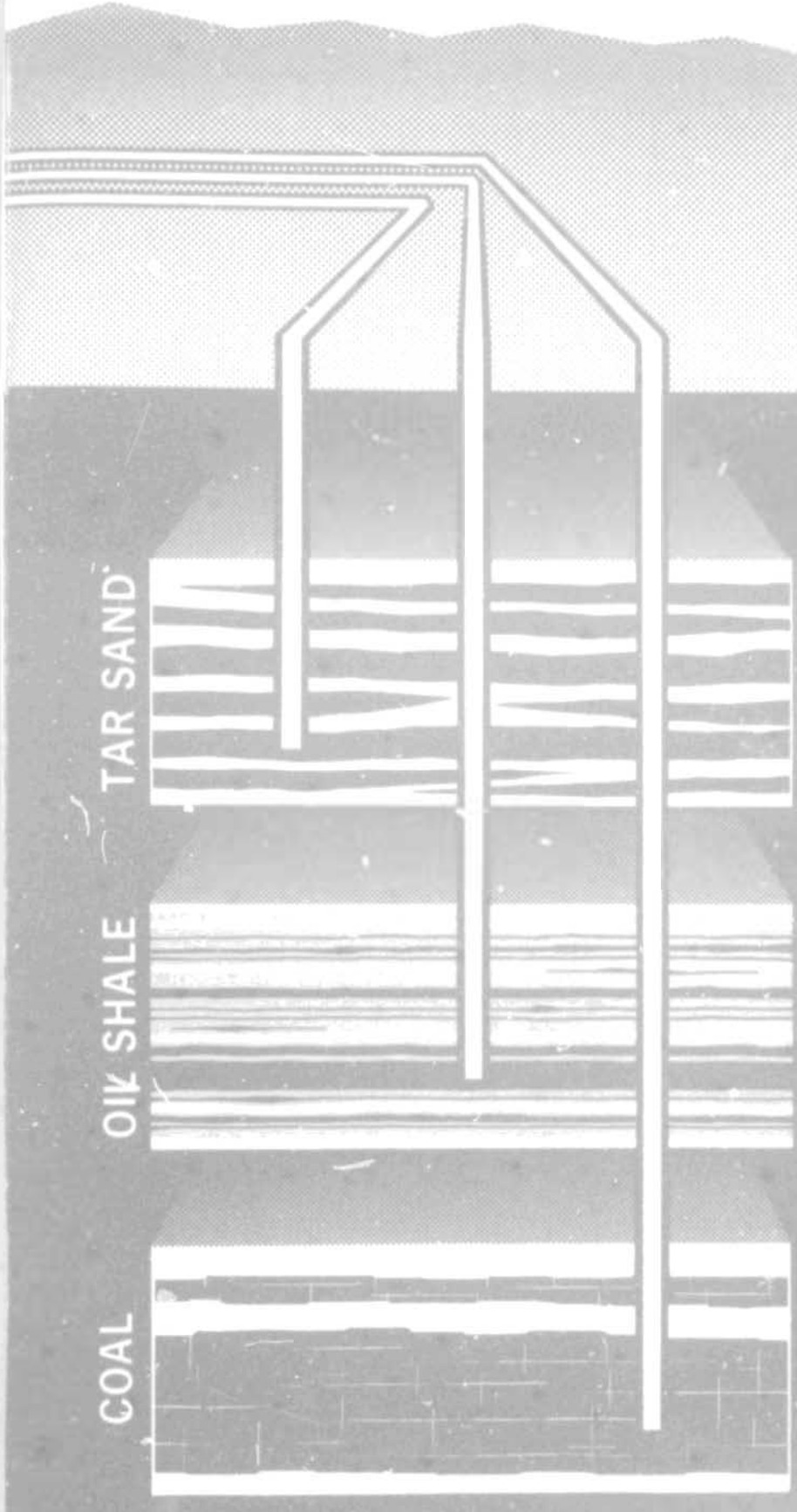


1980 ANNUAL REPORT

LARAMIE ENERGY TECHNOLOGY CENTER

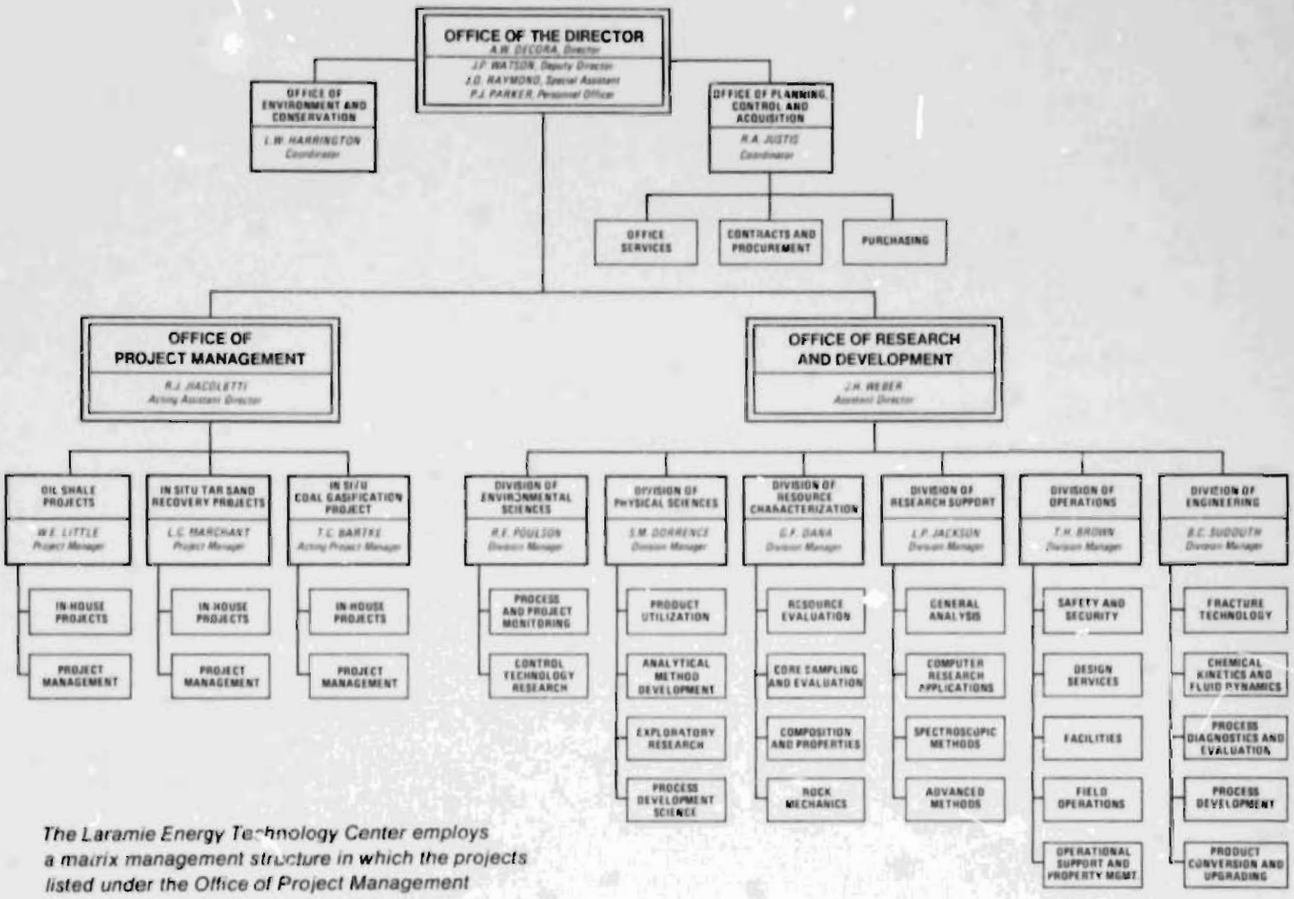
UNITED STATES
DEPARTMENT OF ENERGY

Organization Chart

(pending formal approval)

LARAMIE ENERGY TECHNOLOGY CENTER

U.S. Department of Energy



The Laramie Energy Technology Center employs a matrix management structure in which the projects listed under the Office of Project Management are staffed from the functional divisions under the Office of Research and Development.

DATE: OCTOBER 1980

1980 ANNUAL REPORT

LARAMIE ENERGY TECHNOLOGY CENTER

Andrew W. Decora, Director

DIRECTOR'S MESSAGE

TO: ALL EMPLOYEES

Laramie Energy Technology Center (LETC) has entered the 1980s – a decade in which our nation's limited resources require maximal utilization. Pressures were exerted in 1980 which seriously curtailed our human resources. In the 1979 Annual Report, I indicated that, "in proportional terms our human resources have not kept up with budget increases." I also stated that the quality and competence of LETC employees made up for this lack in quantity, and I predicted that this trend would be a harbinger of events as they would likely occur in this new decade. Events during 1980 showed this prediction to be close to reality.

In spite of a confusing, unclear, and controversial status of our exact energy situation, energy is a critical issue for the nation. Each of you, as a LETC employee, should feel strongly that your efforts, along with those in other Department of Energy (DOE) technology centers and laboratories, will help our country achieve an improved energy pc ture. Again, I wish to reemphasize the Center's goal: **The maintenance of an expert Federal government energy laboratory in the fossil energy heartland of the United States, complemented by cooperative relations with major Western universities.**

International recognition of LETC's work continues to grow. My nomination by the United States government, and subsequent selection by a United Nations Secretary-General, to participate as an expert member of the Technical Panel on Oil Shale and Tar Sand represents not only a personal honor, but a tribute to the Center's achievements.

This panel (of which I was subsequently elected chairman) held meetings at the United Nations Headquarters in New York City during January and at the United Nations Office in Geneva, Switzerland, during October.

Also, in October, our Center received additional international recognition. The Director of Energy from the government of Morocco and I served as Co-general Chairmen of an oil shale colloquium held in Rabat, Morocco. This colloquium was cosponsored by the Kingdom of Morocco, the Agency for International Development of the U.S. State Department, and the U.S. DOE. Most of the world's leaders in oil shale technology attended this colloquium, which had as its major objective the presentation of United States' oil technology to the Moroccan government.

Last year, I served, together with DOE Headquarters personnel, in a review held in Jersusalem, Israel, where we participated in discussions with officials of the Israeli government regarding their plans to build a 20,000 to 40,000 barrels-per-day oil shale plant.

LETC was again on the agenda of a substantial number of foreign and domestic visitors. We hosted 35 individuals, representing 11 foreign nations.

During the first half of the year, DOE participated in negotiations for oil shale demonstration contracts, and, in June, Superior Oil Company and Paraho Development Corporation were awarded the contracts for oil shale facility designs. I was named the responsible Federal official for field management of these contracts.

To assist in this increased responsibility, the former Denver Project Office of the San Francisco Department of Energy was assigned project management responsibilities for these Surface Oil Shale Demonstration Projects. Mark Silverman is the Deputy Director of this Office.

A key position at LETC, that of Deputy Director, was also filled during the year, with the appointment of James P. Watson. Jim comes to LETC very well qualified and is responsible for the internal management functions of the Center.

Dr. Richard J. Jiacoletti was appointed as Assistant Director, Office of Project Management. Dick replaces Chuck Brandenburg, who resigned in 1980 to enter private industry.

LETC's continuing cooperation with the University of Wyoming was again evidenced in September, when a new cooperative agreement was signed by both institutions. This new agreement formalizes joint studies in the development of new energy extraction and utilization technologies, and those aimed at determining potential impacts and impact mitigation strategies arising from such technology.

High ranking officials visited and were briefed on LETC activity in oil shale country. Secretary of Energy Charles W. Duncan, Jr., along with Scott M. Matheson, Governor of Utah and Gunn McKay, U.S. Representative from Utah, visited the DOE/LETC Tar Sand Field Experimental Site in April, and Dr. John Sawhill, Chairman of the Synthetic Fuels Corporation, and his party toured points of interest in oil shale country in November.

LETC lost the services of six veteran pioneers of oil shale technology in 1980. These "old-timers" who retired were: Bill Haines (37 years); Ward Smith (32 years); Bill Robb (36 years); Web Robinson (34 years); Tom Sterner (26 years); and Harold McCabe (25 years). We regret losing such valuable employees representing a total of 190 years of devoted and competent Federal service.

The year of 1981 should be a good one, to which we can all look forward. I am sure that it will be another successful year with your continued loyal cooperation and perserverance.

Justin W. Dearo

TABLE OF CONTENTS

LETC MANAGEMENT

PROJECT MANAGEMENT

Dick Jiacoletti, Assistant Director
Nadine Hurd, Secretary

Functional Summary

- provides the management structure for all projects and designated activities
- coordinates development and execution of implementation plans
- directs and supervises project side of Center Matrix

DIRECTOR'S OFFICE

Andrew Decora, Director
Jim Watson, Deputy Director
Betty Stratton, Director's Secretary

Functional Summary

- responsible for overall leadership of:
  - managerial and administrative activities
  - organization development
  - public affairs
  - equal employment opportunity
- directs and coordinates environmental policy
- implements compliance and regulatory requirements
- acts as regional focus for DOE interactions with:
  - other federal agencies
  - state governments
  - local governments
  - universities
  - private industry
  - national laboratories

RESEARCH & DEVELOPMENT

Jim Weber, Assistant Director
Janice Taylor, Secretary

Functional Summary

- provides management and technical direction to six divisions
- maintains and develops LETC technology base
- provides technical expertise for project efforts
- directs and supervises functional side of Center Matrix

ENVIRONMENT & CONSERVATION

Larry Harrington, Coordinator

Larry Harrington talks with members of the audience at a public scoping meeting in Denver for the EIS on DOE's Surface Oil Shale Demonstration. At this meeting the public identified environmental issues associated with the demonstration of a full-size surface retort module.

Personnel make plans for reclamation of the Rock Springs site. Here OE&C coordinates with Environmental Sciences, Operations, and Resource Characterization to review reclamation details.

Functional Summary

- **assists in cooperative agreement negotiations**
- **drafts environmental assessments, environmental impact statements, and permits**
- **implements the Resource Conservation and Recovery Act**
- **works with public and other government agencies**

Increased public participation highlighted 1980 for the Office of Environment and Conservation (OEC). Public scoping meetings for the Surface Oil Shale Demonstration Project Envrionmental Impact Statement (EIS) were held in Vernal, Utah, and Rifle and Denver, Colorado, in August. The meetings identified critical environmental issues associated with the construction of demonstration surface-oil shale modules.

This office assisted in the negotiation of cooperative agreements to design the full-size modules for which the public scoping meetings were held. Negotiations were conducted with Superior Oil, Tosco Corporation, and Paraho Development Corporation. Agreements were eventually reached with Superior and Paraho. The EIS for the full-size modules was initiated in 1980 to assist the Department of Energy in determining whether or not to follow up the design of the modules with construction and operation.

The draft EIS for a separate full-size module at the Anvil Points oil shale facility was completed and published in 1980. Public comments on this draft EIS were received in November. The comments will greatly assist DOE in reaching a decision on how to best utilize Anvil Points in the future.

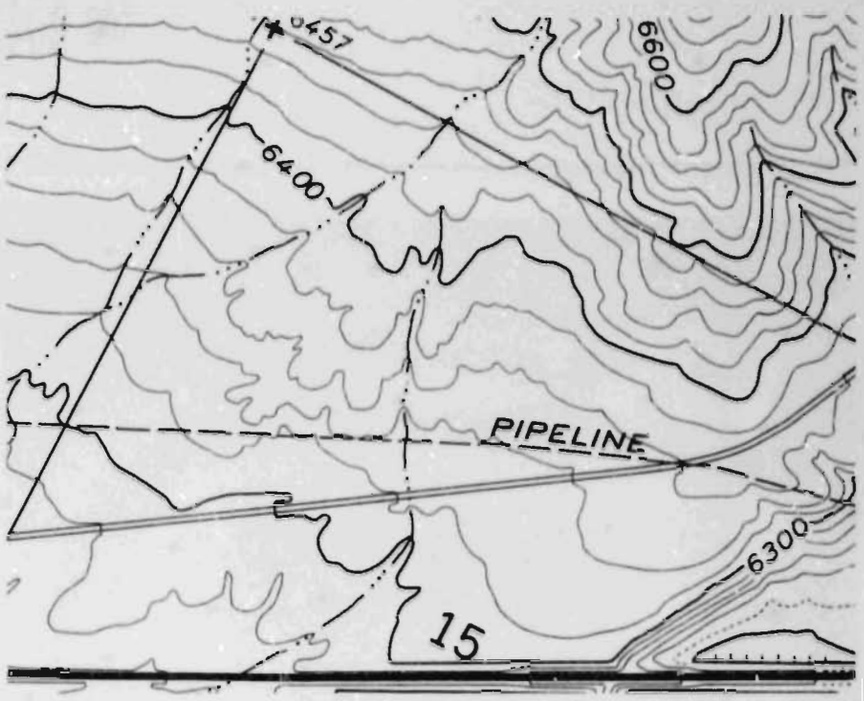
Work continued on government/industry cooperative oil shale projects with Geokinetics, Equity Oil, and Occidental Oil Shale. The Environmental Assessment (EA) for the remaining work at Geokinetics was completed and published. The EA for Phase II of the Occidental Oil Shale work at the Logan Wash site was completed and published. Monitoring of permitting and compliance activities continued on all three of these projects.

LETC began extensive collection of ground water and geologic data at the Hanna underground coal gasification site in 1980. This data will be used to determine reclamation requirements of the site by the State of Wyoming. Four underground coal gasification experiments were conducted on the site in the 1970s. OEC will continue the preparation of the reclamation plan or the Hana facility.

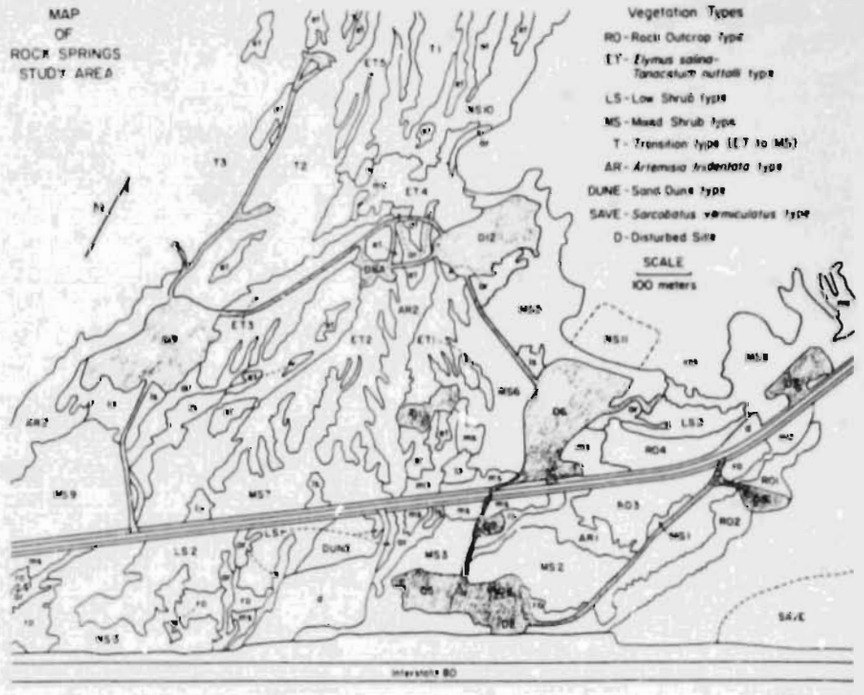
OEC prepared the EA and operating permits for LETC's first steam injection tar sand experiment (TS-IS). Detailed monitoring and mitigation plans, environmental failure modes and effects analysis, and spill prevention, control, and counter-measure plans were prepared and implemented on the tar sand site west of Vernal, Utah, for the TS-IS experiment. An inspection and audit program based on a monitoring and mitigation plan was initiated in the early construction stage of the experiment and continued through the decommissioning of the site. The TS-IS experiment was the first LETC project to be conducted in accordance with the DOE Environment, Safety and Health Orders.

LETC worked very hard in 1980 to comply with the rules and regulations of the Resource Conservation and Recovery Act. Several LETC employees were trained in the legal requirements for dealing with the disposal of hazardous wastes generated by LETC.

LETC projects increased in size and significance during 1980. Increased personnel in OEC will allow further public participation in these projects. Public input to our compliance documents, such as Environmental Impact Statements, will help DOE make better decisions concerning LETC projects. OEC will also be better able to monitor LETC projects and mitigate the impacts of these projects as new technologies approach commercialization.



One of this office's activities involves topographic maps (upper) to produce vegetation maps of LETC's deactivated field sites. The lower map shows the disturbed and undisturbed areas before reclamation efforts have begun. This step is just one part of the Center's response to the reclamation regulations of the Wyoming Department of Environmental Quality.



PERSONNEL

Peggy Parker, Personnel Officer

Kathy Jacobson, Kathie Perry, and Peggy Parker reviewing new Performance Standards and Appraisal System.

Kathy Jacobson begins another position classification effort.

Functional Summary

- position classification and position management
- employee relations and benefits
- Privacy Act and Freedom of Information
- recruitment and staffing
- self development and training
- personnel records
- development of local policies and procedures
- EEO and upward mobility implementation

The impact of changing and adding regulations and programs has had a profound influence on the operations of the Personnel Office in 1980.

This impact, plus our customary routines, increased our level of activity, again making it a hectic but still productive year.

The Personnel Office is responsible for all employee activities, procedures, policies, and contacts involved with the rendering of necessary services to the Center. Because of this critical function, the Personnel Office reports directly to the Director.

Highlights of the year were:

- Personnel were hired to fill the positions of Coal Project Manager, Division Manager of Operations, Division Manager of Physical Sciences, Deputy Director (new position), Assistant Director of the Office of Project Management, Division Manager of Resource Characterization, and staff for the Grand Junction Project Office.
- Positions were established for the surface Oil Shale Demonstration Project Office, Upward Mobility, and Inventory Management.

- 28 full-time personnel and three Stay-in-School positions were lost because of ceiling cuts and hiring limitations.
- A Volunteer-In-Service Program with the University of Wyoming was implemented.
- Superior performance awards were presented to Brenda Manuelito, George Marron, Janice Parker, and Steven Whittenburger.

A total of 218 personnel actions were taken during the year. These actions are as follows:

	Persons Hired	Persons Separated	Net
Permanent Full-Time	7	18	–11
Other Than Full-Time Permanent	37	37	0
Other Personnel Action – 119			

The other personnel actions included 43 promotions, representing 28 percent of our average work force, and six retirements.

It is significant that our turnover rate for the last two years has remained at 11 percent. This is a better rate than the records of industry, academia, and other R&D laboratories.

The LETC matrix type of organization, adopted in 1976, has proven to be an effective manpower utilization medium. This type of organization provides for the formation of project teams as required by shifting or "matrixing" personnel from the functional areas.

The following new personnel policies and procedures were developed and implemented:

(1) Local policies supplementing DOE orders on pay administration, duty hours, and leave administration
(2) Revised Merit Promotion Plan
(3) Employee Development and Training Policy
(4) Revised Applicant Supply Procedures – Competitive (Temporary)
(5) Revised Applicant Supply Procedures – Excepted Positions

LETC's staff has more than a dozen different health insurance and hospitalization plans to choose from through this office.

A copy of every official personnel document is confidentially maintained in the Personnel Office. Kathie Perry works with these on a regular basis.

Fingerprinting – a requirement of LETC's hiring process.

(6) Volunteer In-Service Policy
(7) New Performance Standards and Appraisal System
(8) Merit Pay Determinations
(9) Federal Equal Opportunity Recruitment Program

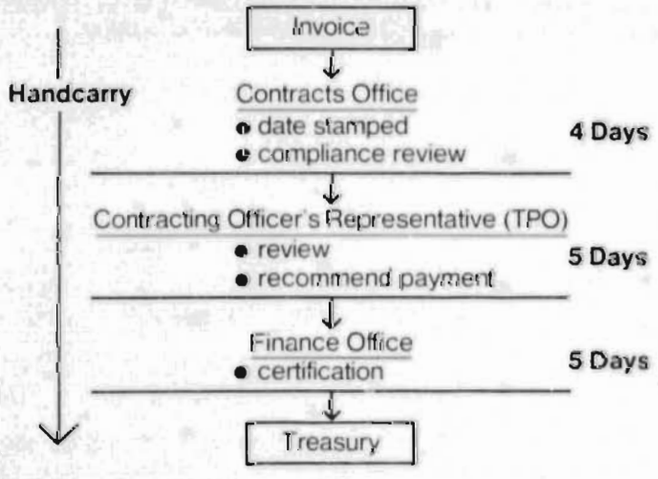
Training increased by 58 percent in 1980. LETC employees completed 275 training courses during the year. This increased emphasis on training assures us of a thoroughly qualified work force more capable of successfully completing our mission. Seven of these training courses were on-site programs.

Forty-seven percent of the LETC work force is now comprised of employees under age 40, which is about the same percentage we had in 1976. In 1980, 40 percent of LETC employees had 15 or more years of Federal Service. The average LETC employee is 42.3 years old, with 12.4 years of Federal Service.

PLANNING, CONTROL, & ACQUISITION

Dick Justis, Coordinator

A lighter moment in a conference between Dick Justis, Planning and Control Coordinator, and LETC Contracting Officers Bob Rucinski, Lynn Benson, and Rich Marron. Such meetings serve to assure uniformity in the execution of Contracting Officer responsibilities.



The above diagram illustrates the expedited flow of invoices. The procedure was implemented to make maximum utilization of available payment discounts.

Functional Summary

- **institutional planning, control, and evaluation**
- **systems analysis**
- **contracting and purchasing**
- **budget formulation and accountability**
- **financial management**
- **word processing**
- **mail services and duplicating**
- **telecommunications**
- **forms and records management**

The Office of Planning, Control and Acquisition (OPCA) exemplifies the transition that has taken place at LETC and the management capability that now exists to support the development of in situ technologies. The DOE Fossil Energy's research and development program has expanded to include a much higher level of participation by universities, industry, and state and local governments as developing technologies become increasingly critical. Likewise, the role of the Federal researcher has broadened to include technical program planning, field site management, contract administration, technical information dissemination, and project management. OPCA has acquired the skills and developed the capabilities necessary to support these technology development managers in the performance of their duties.

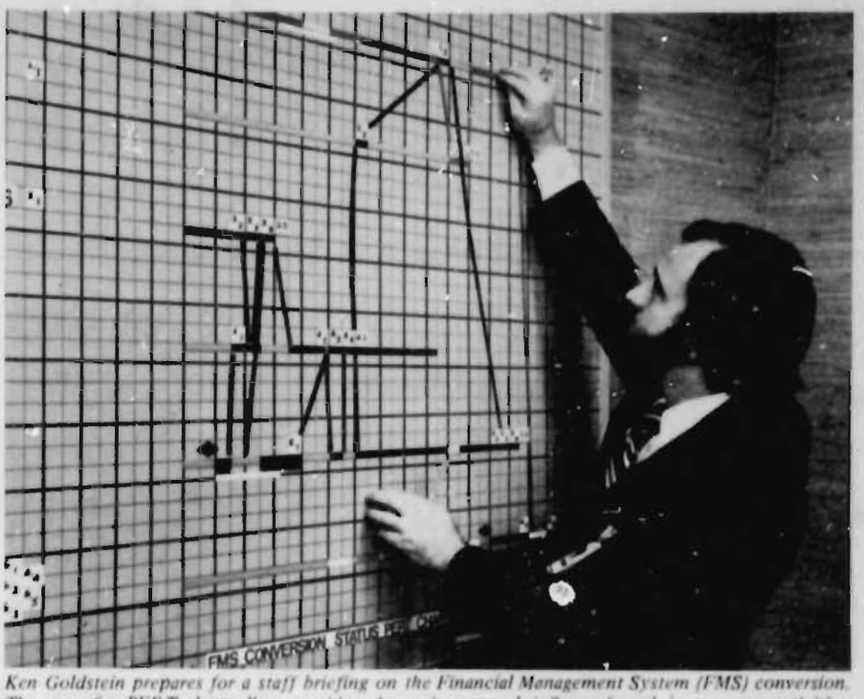
Planning and systems analysis is at the forefront of this support effort. This function provides the structure for policy input to program formulation and the trade-off analysis between alternative projects competing for limited resources. It further provides for the allocation and accountability of all Center resources, and serves as the vehicle by which Center objectives are translated into action plans. Planning and systems analysis is the

coordination point for all Center planning activities and the liaison with DOE Headquarters on similar efforts.

The area within OPCA that has undergone the most significant change as far as personnel is concerned is that of contracting. Two years ago, the contracting function at LETC was performed by two individuals. Today, there are eight. The contracts section is now capable of awarding and administering the complete spectrum of acquisition instruments including contracts, grants, and cooperative agreements. The degree to which the LETC development program has expanded to include the work of others is revealed in the fact that a great majority of the LETC budget is expended through contractual arrangement. Many of these contracts involve complex, unprecedented research procedures, while others are unique, one-of-a-kind partnership type agreements. The contracts section has developed, and continues to expand upon, a growing base of skill and talent capable of meeting the particular and often peculiar requirements of the Center.

The acquisition function is also supported by a skilled purchasing office which provides the seemingly unending variety of supplies and services necessary to maintain a major research facility.

Another area that has experienced considerable change is financial management. As the Center's level of fiscal responsibility has increased, so has the level of activity in this area. Five individuals are now directly involved in our budget and finance branch. They process tens of thousands of financial transactions, provide funds accountability, and supply managers with financial information. They are the focal point for budget formulation and tracking in an environment of constant change and revision. Working in concert with the acquisition branch, they process invoices for payment by the U.S. Treasury and provide accurate accounts of obligations and costs.

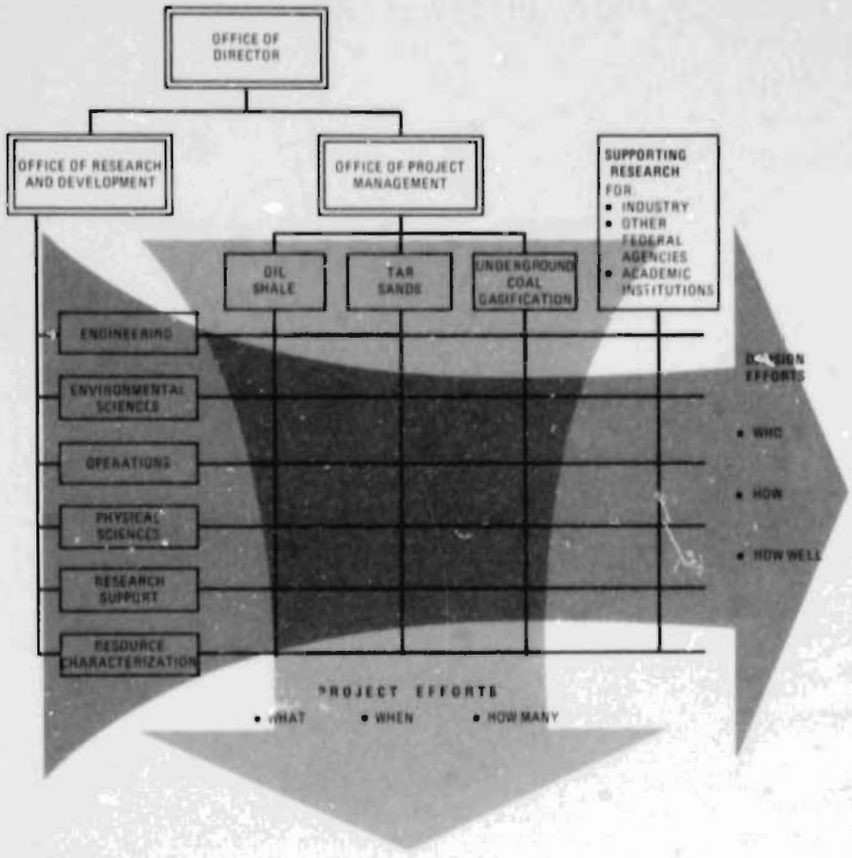


Ken Goldstein prepares for a staff briefing on the Financial Management System (FMS) conversion. The use of a PERT chart allows rapid and concise status briefings of work in progress, activities, events, and schedule changes.

The office services branch also supports the Center in the areas of word processing, duplicating, mail distribution, telex and facsimile transmission, telecommunications, and forms and records management.

In summary, OPCA now incorporates the necessary expertise to provide the planning, systems analysis, and administrative support required in the execution of its technology development mission. As an extension of the Director's office, it serves as a central point wherein all Center activities are coordinated. This mix of talent and ability has been assembled on an accelerated basis to meet LETC's changing requirements. With it, we are prepared both to function in our current role and to handle increased responsibilities to come.

MATRIX MANAGEMENT



At the heart of LETC's organizational approach is a management principle known as "matrix organization."

LETC's matrix is a dynamic management philosophy, designed to allow maximum flexibility to meet ever-changing research challenges while making the best use of existing staff capabilities. In LETC's application of this principle, the "matrix" idea refers to the relationship between the individual projects under the Office of Project Management and the six permanent functional divisions under the Office of Research Development.

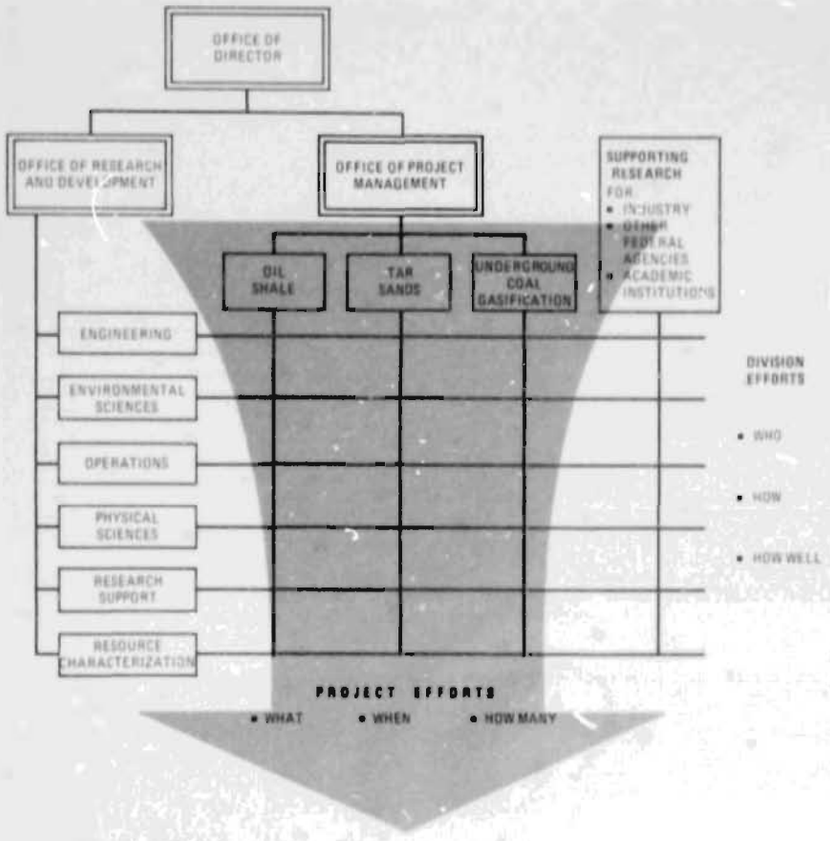
In the matrix organization, project managers draw upon the technical skills of functional divisions to design and operate, or to monitor major field projects. Division managers have additional responsibilities to accomplish supporting research and to assure continuing growth of a technology base.

In practice, the matrix organization requires a sharing of resources between the projects and the divisions. This is accomplished through a negotiation process. Each project office and division then assumes responsibility for managing a specific portion of the Center's budget. LETC's financial management system provides a comprehensive means for monitoring all such transactions.

The following section summarizes the *vertical* component of this matrix, the Office of Project Management.

PROJECT MANAGEMENT

Dick Jiacoletti, Assistant Director
Nadine Hurd, Secretary



Functional Summary

- **provides the management structure for all projects and designated activities**
- **coordinates development and execution of implementation plans**
- **directs and supervises project side of Center Matrix**

The Office of Project Management (OPM) is responsible for coordinating the development and execution of implementation plans. It also oversees management responsibilities and authorities for all project support activities for the technologies being developed by LETC. The office is organized with three projects managers, under an Assistant Director for Project Management. The Assistant Director and the projects managers provide technical and management leadership for all assigned projects and activities. The Office of Research and Development (ORD) provides technical personnel to manage specific projects and contracts, and provides technical expertise in support of project activities. Consequently, the management structure is a matrix, requiring close coordination and cooperation between the ORD and the OPM.

The major projects of the DOE Oil Shale Program are cooperative ventures with an industrial partner(s). In 1980, the vertical modified in situ (VMIS) project, operated by Occidental Oil Shale, Inc., reached the final stages. The commercial-scale VMIS test retorts, designated 7 and 8, were constructed. The horizontal in situ project, operated by Geokinetics, Inc., also reached the

commercial-scale retort phase. An office was established in Grand Junction, Colorado, for the technical management of the Occidental contract by the OPM. The Geokinetics contract and several smaller and more developmental process contracts are managed by OPM from LETC.

The 1980 DOE Underground Coal Conversion (UCC) activities were focused on planning additional field experiments and evaluating previous experiments. OPM coordinated the development of a plan for field testing of the underground coal gasification (UCG) process in Washington State. Negotiations with the owners of the land and operators of the coal mine were initiated. The steeply dipping beds (SDB) underground coal gasification project, operated by the Gulf Research and Development Company, advanced to the design of a second test after a post-burn coring and evaluation of the first test. Some preliminary site preparation was also accomplished. This project came under the technical management of OPM during 1980.

The first steam injection field test in the DOE Tar Sand Program was conducted during 1980. The results of this experiment have been evaluated, and are being incorporated into the design of a second larger steam injection experiment, which should be completed in 1981.

TAR SAND

Lee Marchant, Project Manager
Loretta Harak, Project Secretary

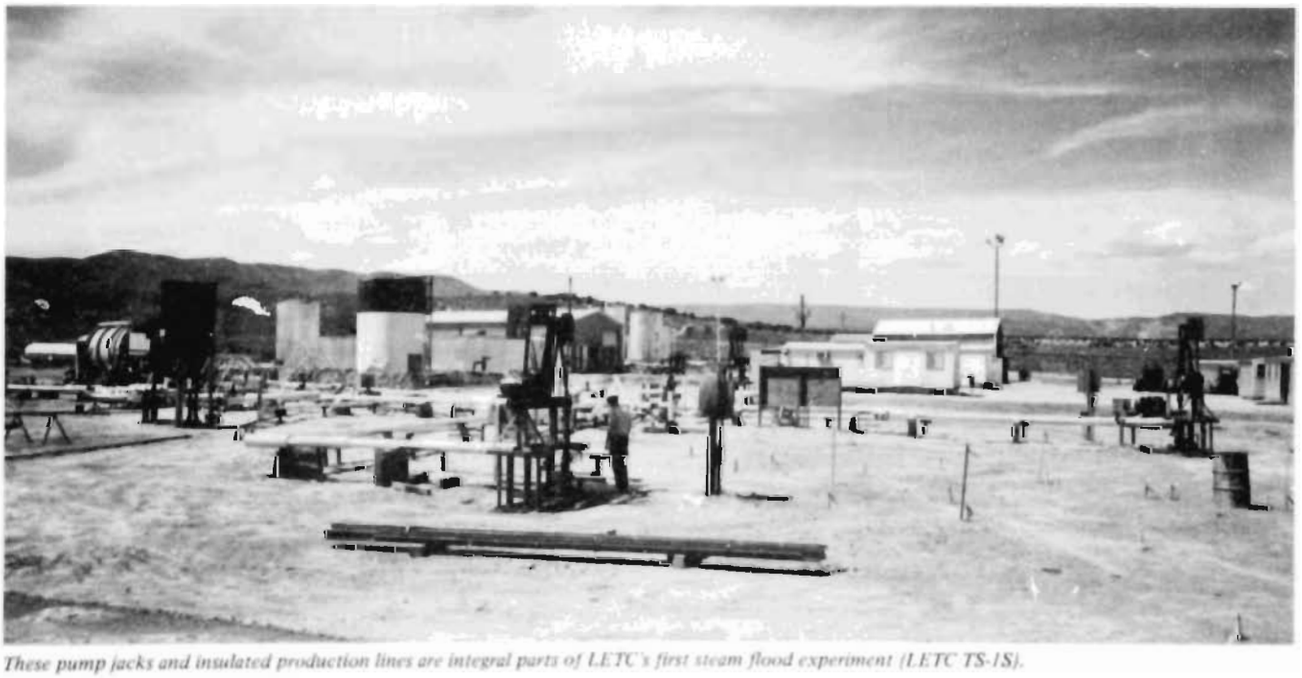
The LETC Tar Sand Experiment Site is located four miles west of Vernal, Utah.

Functional Summary

- **develops coordinated implementation plan for tar sand program**
- **executes tar sand implementation plan**
- **manages government/industry cooperative agreements**

LETC is conducting thermal oil recovery field experiments and laboratory research to develop in situ technologies for the production of fuel from U.S. tar sand deposits.

Tar sand deposits in the United States are estimated to contain over 36 billion barrels of extremely viscous bitumen, a thick oil-like material. Over 80 percent of this material is found in several large deposits in Utah, although



These pump jacks and insulated production lines are integral parts of LETC's first steam flood experiment (LETC TS-1S).

occurrences are known in 22 states. The bitumen is not recoverable by primary oil production methods due to the extreme viscosity and lack of reservoir energy. Thermal processes that reduce bitumen viscosity by heat and displace bitumen to wells for production appear to offer the greatest potential for tar sand oil recovery.

The first LETC in situ steam flood field experiment, LETC TS-1S, was conducted in 1980. The test was to determine the feasibility of producing bitumen by the heating and displacing action of injected steam. Steam injection was initiated in the center well of two concentric inverted five-spot patterns in April 1980 (see diagram fig. 3). Oil production of 1,150 barrels accounted for 5.7 percent recovery of the oil in place during 160 days of operation. The steam injection rates ranged from 250 to 704 BPD water equivalent at well head pressures of 360 to 530 psig. Steam injected during the experiment was equivalent to 66,800 barrels of water. Environmental monitoring documentation for the LETC TS-1S field experiment included an approved Environmental Impact Assessment, an Environmental Monitoring Plan, a Spill Prevention Control and Counter Measures Plan, an Air Quality Permit, a Waste Water Storage and Disposal Permit, and a Solid Waste Disposal Permit.

The Secretary of Energy, James Duncan, and the Governor of Utah, Scott Matheson, visited the LETC Tar Sand Experimental Site on April 17, 1980. Lee Marchant, Projects Manager, and Dr. Andrew Decora, Center Director, (far right) explain final preparations for the first steam flood experiment to (left to right) U.S. Congressman Gunn McKay, Utah Senator Moroni Jensen, and Governor Matheson.

This well-servicing unit is only one part of the steam flood experiment's maintenance program.

The produced fluids manifold for the steam flood experiment awaits application of insulation.

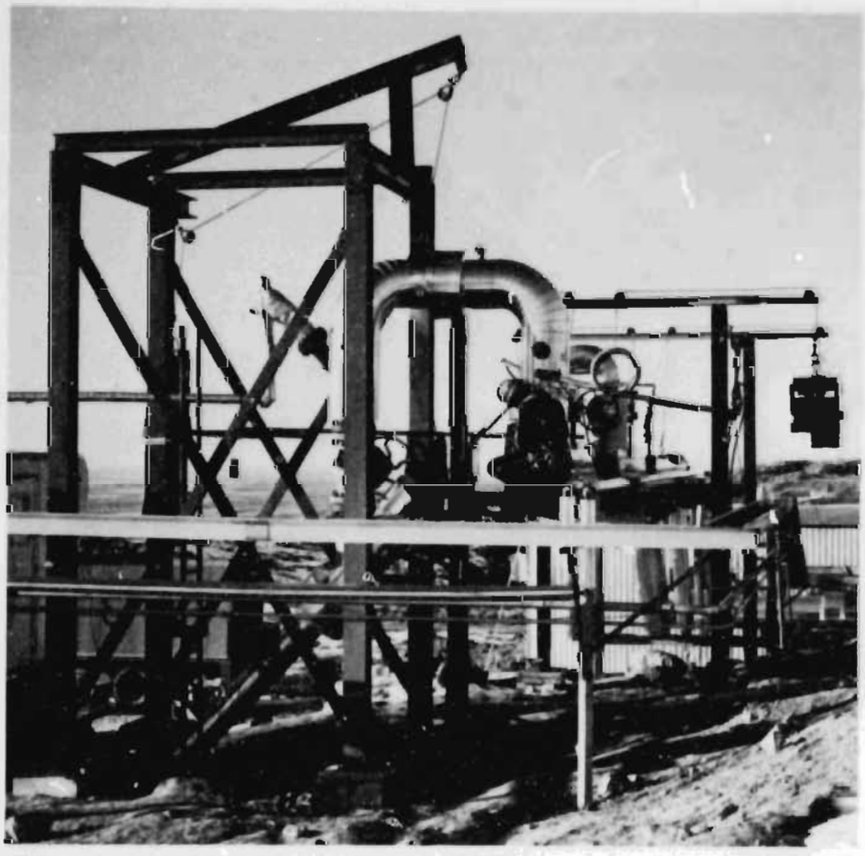
A computerized resource data base is being assembled for the tar sand program. Contributions to this data base in 1980 included analyses of seven cores from Utah's P.R. Spring deposit and a compilation of available in-house and outside data. Los Alamos Scientific Laboratory (LASL) has been assembling engineering, geological, environmental, and other data to assist in the prioritization of several major deposits.

Other projects by LETC and support organizations include research on tar sand processing in surface plants, separation of oil-water emulsions, economic evaluation of in situ oil recovery processes, physical properties, and upgrading of the products. LASL published a report during the year on a preliminary economic evaluation of the in situ combustion process, based on LETC field experiment results. The University of Wyoming is researching viscosity-temperature relationships, thermal conductivity, and heat capacity of tar sand materials. Research is also being done on vis-breaking, delayed coking, catalytic cracking and hydropyrolysis of tar sand bitumen at the University of Utah.

DOE, through LETC, is cooperating with the Canadian government, and the Alberta and Saskatchewan provincial governments, in research and development programs for tar sand and heavy oil. Six potential cooperative projects have been developed. These international cooperative efforts could save time, reduce costs, reduce technical risks, improve the respective research and development programs of the two countries, and encourage expanded activities toward commercialization of tar sand resources.

COAL

Theodore Bartke, Project Manager
Nadine Hurd, Project Secretary



Slant production well of the Steeply Dipping Beds UCG Test 1. DOE and the Gulf R&D Co. are investigating the feasibility of UCG in steeply dipping beds of coal near Rawlins, Wyoming.

Functional Summary

- **develops coordinated implementation plan for UCC program**
- **executes UCC implementation plan**
- **manages government/industry cooperative agreements and cost-shared contracts**

After the completion of four UCG field tests in 1979, the DOE implementation program for 1980 was designed to evaluate the results of previous field test. Three field test sites, Hanna II (phases 2 and 3), Hoe Creek 3, and Rawlins Test 1, were cored, and the cores analyzed to determine post-burn characteristics. In addition:

- The DOE/Gulf Research & Development Company contract was modified to include a second steeply dipping coal bed UCG test. The contract technical management responsibilities for this contract were assigned to LETC.
- A draft report of UCG potential in Washington State by LETC, Sandia, and Lawrence Livermore National Laboratories was prepared.
- A preliminary plan was drafted for continued UCG activities in Washington State.
- A sixth annual Underground Coal Conversion (UCC) Symposium was sponsored by DOE/LETC at Afton, Oklahoma.

Hanna

Although additional UCG field tests are not planned at Hanna in the near future, there was considerable activity at the site during the year. A Wyoming Department of Environmental Quality (DEQ) R&D license necessitated major environmental monitoring efforts at

Hanna, particularly in the area of ground water quality. LETC's In Situ Hydrology Task Force (ISHTAF) obtained the necessary data for this license. These data required a significant drilling, coring, and logging program at the Hanna site, followed by a ground water sampling and analysis program. The sampling and analyses will continue for several years. The Divisions of Resource Characterization and Environmental Sciences will conduct the sampling and analysis programs. The Office of Environment and Conservation will provide interpretation of the data and submit the license application to the DEQ.

Additional funds were made available for the postburn coring and evaluation of Hanna II, phases 2 and 3. Ten rotary holes were drilled to determine the approximate burn zone boundaries, then 12 additional holes were drilled, cored, and logged for core analysis purposes. These have been analyzed, and the results will be reviewed and interpreted.

Hoe Creek

Additional funds were also made available to Lawrence Livermore National Laboratory (LLNL) for the post-burn coring of Hoe Creek 3. After inspection, LLNL will ship core samples to LETC to be included in the ongoing analysis and evaluation of post-burn cores.

Rawlins SDB Test 1 and Test 2

In 1980, additional funds were made available for the post-burn coring and evaluation of SDB Test 1 and some site preparation for Test 2. Primary project activities during the year have been the design of SDB Test 2, and the modification of the contract to reflect changes in the design and costs of SDB Test 2.

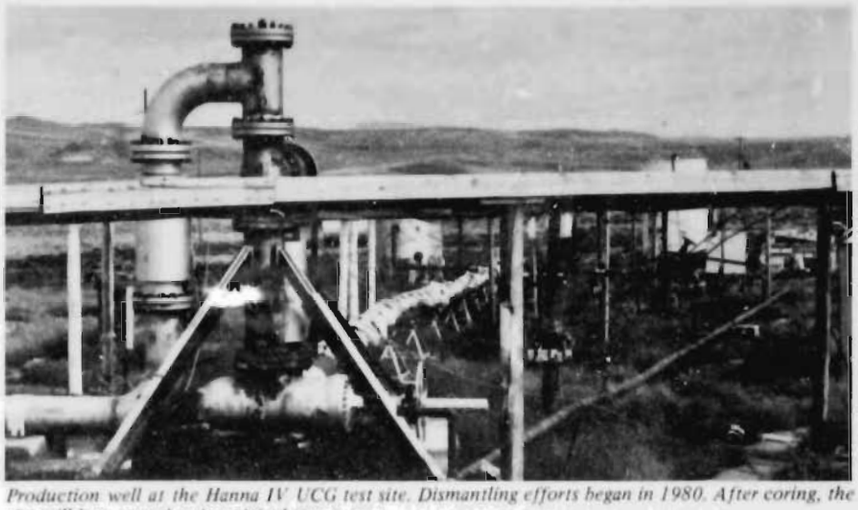
Tono Project

In 1979, Congress appropriated funds to investigate the feasibility of in situ gasification of coals in the state of Washington. Tono Basin, within the Centralia-Chehalis district, was chosen for detailed characterization because: (1) a large quantity of subbituminous coal is contained in the Centralia-Chehalis district, (2) although the geology of the district is complex, there is enough gentle-to-moderate geologic structure to warrant consideration as an underground coal gasificaiton site, and (3) a potential market, the Centralia Steam Electric Generating Plant, is sited within the district.

A preliminary plan for a UCG field test in the Tono Basin was developed during the year, based on the preliminary site characterization results. The test should provide: (1) an assessment and correlation of preburn site characteristics and the gasification process, (2) an assessment of product gas quality and its potential use, and (3) an assessment of the environmental effects of the UCG process on local water, air, and land quality.

As lead center for implementation of the DOE UCC program, LETC will provide project management and technical support for the Tono Project.

The Sixth Annual Underground Coal Conversion Symposium, sponsored by DOE/LETC, was held in Afton, Oklahoma in July. Sixty-seven papers, covering a broad range of topics important in UCG technology, were presented. A number of papers, by LETC personnel or sponsored by DOE/LETC, were presented.



Production well at the Hanna IV UCG test site. Dismantling efforts began in 1980. After coring, the site will be restored to its original appearance.

A potential UCG test site in the Tono Basin near Centralia, Washington. DOE is preparing a new test site starting with a series of coal face tests in 1981. The site has been characterized and found suitable for UCG testing.

OIL SHALE

Bill Little, Project Manager
Charlotte Miller, Project Secretary

This view of Oxy's Logan Wash site shows two mining levels – one about 300 feet above the other. This 300 feet of shale outcrop contains about 80 feet of the rich Mahogany Zone. Large retorts are formed and processed between these two mining levels to obtain design and operating data that will be applied to development of the vertical modified in situ process.

Functional Summary

- **develops coordinated implementation plan for oil shale program**
- **coordinates the execution of the oil shale implementation plan**
- **manages government/industry cooperative agreements**
- **manages DOE Anvil Points Facility**

During 1980, the Fossil Energy Oil Shale Program concentrated on coupling relevant research and development activities with major field projects. Emphasis was placed on the use of the field project sites as laboratories, where concepts developed in small-scale laboratory experiments could be tested at or near full-scale.

Occidental Oil Shale, Inc.

Phase II of the Cooperative Agreement

Larry Morris, Geokinetics Analytical Branch Manager, working in field laboratory where water, product gas and oil analyses are made.

Bill Little, (center) Oil Shale Project Manager, meeting (left to right) Pedgray Janjic, Milan Stojanovic, Branko Kapor, and Ivan Mijatovic. The Yugoslavian delegation visited LETC to investigate oil shale recovery methods that may apply to the oil shale resources of Yugoslavia.

Withdrawing a sample of shale oil from the heater-treater at the Equity Bx project is Tom Holen, Operations Supervisor for Stearns-Rodger.

with Occidental Oil Shale, Inc., began on June 1, 1979. This phase includes: (1) the rubbling of five small (¼-sized) retorts to better define blasting parameters, and (2) the mining, rubbling, and retorting of two commercial-sized retorts (165' x 165' x 260' high). Two of the ¼-sized retorts are to be partially retorted to test two different retort ignition systems: a direct fired and a hot inert gas generator. The two large commercial retorts (7 and 8) are to be retorted simultaneously starting about December 1981.

Major accomplishments this past year include the completion of all drift and void space mining for both the ¼-sized retorts and retorts 7 and 8, and the start-up of an ignition test of one of the smaller retorts. Much of the construction, instrumentation installation, and environmental support are well underway in preparation for the ignition of the two large retorts.

Geokinetics, Inc.

During 1980, Phase 5 of the Geokinetics oil shale project was concluded and Phase 6 was initiated. The project is located 70 miles south of Vernal, Utah. Geokinetics is testing a concept for horizontally retorting relatively thin seams of oil shale that lie under shallow overburden (less than 100 feet). By drilling blast holes through the overburden and into the shale bed (about 30 feet of shale) and then blasting the formation, the overburden is raised and the shale bed rubbled. This allows for permeability in the underlying shale.

Air-in (injection), off gas-out and production wells, as well as instrumentation wells, are then drilled into the rubble-zone and appropriate piping and instrumentation installed. Finally, the rubbled shale zone is ignited at one end, retorted horizontally, and the products are removed at the other end.

The last Phase 5 retort was 108' wide x 156' long x 18' thick with 26' overburden. Retorting produced 5,547 barrels of shale, which represents a recovery of oil approximately 50 percent based on Fischer Assay. The first Phase 6 retort is the size (217 x 230 x 30) now considered commercial. This retort contains a potential of 50,000 barrels of oil and a 50 percent yield is expected. It has been prepared and ignited.

Equity Oil Company

Small quantities of shale oil are being produced from two production wells at the DOE/Equity Oil Company Bx in situ oil shale project, located west of Rio Blanco, Colorado. Steam injection was initiated in September, 1979, to demonstrate the technical feasibility of using superheated steam to retort in situ oil shale in the Green River Formation "leached" zone. Problems with the superheater limited the continuous injection primarily to saturated steam injection; injection of superheated steam was possible for only four months.

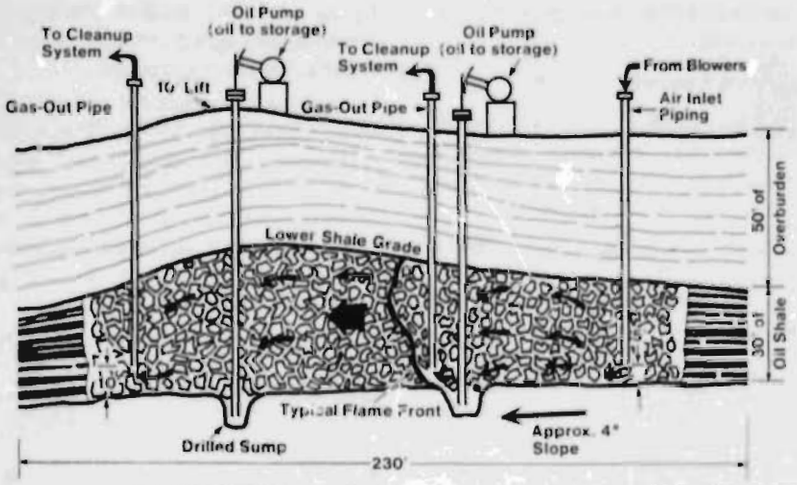
A new higher pressure heater-treater was installed during December, to facilitate separation and handling of the highly viscous shale oil, which is being produced as an oil/water emulsion from two of the five production wells. At the end of December, production from these wells was still very low: a few gallons of shale oil mixed in 500-600 barrels of water per day. Oil production is expected to rise rapidly as more of the formation reaches retorting temperature from the continued injection of superheated steam.

The production wells were modified twice during the past year to enhance water production. In March, the wells were perforated in the lower permeable zone, and, in October, they were perforated in the upper permeable region of the leached zone. This caused a marked increase in water production, and resulted in a change from the initial diagonal sweep pattern of the leached zone to a horizontal sweep pattern.

Illinois Institute of Technology Research Institute (IITRI)

In 1980, IITRI and DOE signed a cooperative agreement for laboratory and field testing of in situ production of shale oil and tar sand bitumen by radio-frequency (RF) heating. Laboratory and analytical studies have been conducted with oil shale samples from three promising field sites: Avintaquin Canyon, Utah, Hells Hole Canyon, Utah, and Anvil Points, Colorado. The laboratory and analytical studies have primarily involved the measurement of dielectric and thermal properties. In addition to the laboratory work, IITRI conducted a short-term field test in the oil shale of Avintaquin Canyon.

Aerial view of the Anvil Points facility looking toward the south. Spent shale disposal pile shown to left and below main retorting facilities. This facility provides government agencies and private enterprise with opportunities for field research in rock fragmentation, retorting and environmental studies.



Artist's conception of a Geokinetics retort depicti[illegible] the burn front and production wells.

Institute of Gas Technology (IGT)

The IGT 18-month contract activity began late in 1979. The objective of the project is to determine the feasibility of retorting eastern Devonian shales at high pressure in a hydrogen atmosphere. The IGT-developed Hytort process will be evaluated. The IGT Hytort Process Development Unit (PDU), a semi-continuous retort capable of operating at hydrogen pressure up to 500 psig, will be used for the retorting. The PDU is designed for throughput rates of up to one ton per hour.

Eastern U.S. shales are of the Devonian geologic age and are hydrogen deficient when retorted by the usual methods used for Western Eocene shales. It may be possible to obtain conversions of up to 80-90 percent of the organic carbon to gas and oil with the IGT process.

Dow Chemical Company

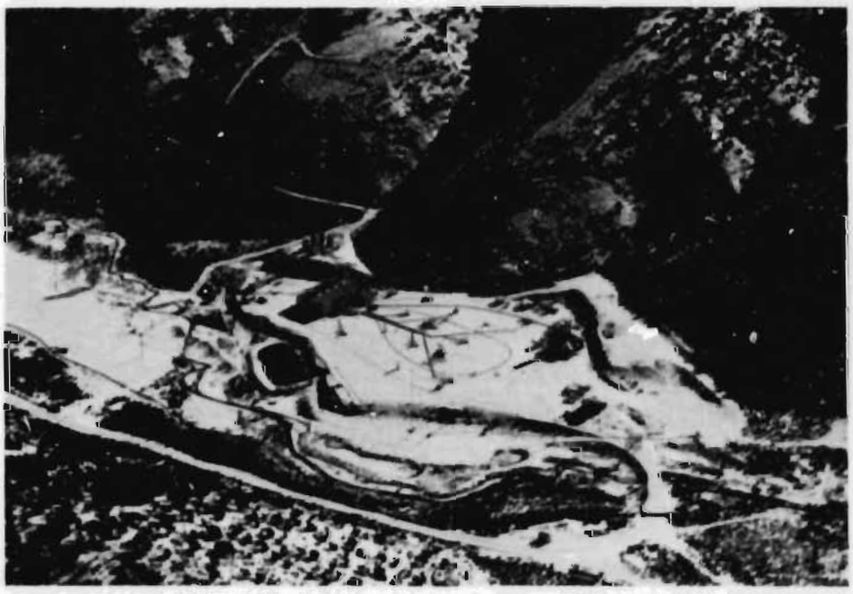
As of October 1, 1980, the DOE/Dow Chemical Company contract, a 48-month feasibility program directed towards in situ extraction methods from Eastern Devonian oil shale (Antrim Oil Shale in the Michigan Basin), was brought to a contractual conclusion. The four-year study consisted of four tasks: (1) Shale Characterization, (2) In Situ Fracturing and Assessment, (3) In Situ Extraction Trials, and (4) Environmental, Public Policy, and Legal Assessment.

Forty-one topical reports were generated in Task 1 and are available from National Technical Information Service. A wealth of data is available on the chemical, physical, geological, mineralogical, and lithological properties of Antrim shale. Large numbers of stratigraphic cross sections and maps were prepared. Task 2 covered the investigation of three techniques for in situ fracturing of Antrim shale. The three procedures were: (1) Hydraulic fracturing followed by explosive fracturing, (2) Chemical underreaming followed by explosive fracturing, and (3) Explosive underreaming.

The Antrim shale was successfully ignited in situ at the explosively fractured site and low Btu gas was produced (5-50 Btu/scf). However, as the formation was heated, the permeability decreased, and significant self-sustained combustion was not achieved before the contract work had to be discontinued. Because interwell communications would return to preburn levels after formation cooldown, thermal expansion of the oil shale was considered as the most likely cause of the permeability decrease. No liquid oils were obtained. No significant environmental impacts were observed other than physical disruption of the land surface.

National Bureau of Standards (NBS) Contract

In mid-1980, development and refinement of high frequency electromagnetic (HFEM) mapping techniques was begun at the NBS laboratories in Boulder, Colorado. The goal of the project is to determine if high frequency electromagnetic radiation can be used as a reliable probe of in situ retort parameters, such as void volume and particle size.



Aerial photo of Bx site with Black Sulphur Creek in foreground. The road to the top of the ridge behind the site leads to a meteorological tower. The water holding pond is on a bench below the site, and the softened water storage tanks are in a bench directly above the steam generation building. High pressure steam lines are visible going to the injection wells on the site and the oil separation building and storage tanks are to the right of the pattern wells.

During 1980, development of a data base of dielectric constant measurements of oil shale samples was begun. The open circuit measurement method used in these studies is significantly different from previously used techniques. The initial results have demonstrated the large influence of inorganic mineral material on the dielectric constant. The construction of a sample holder for simulation of the in situ retorting environment was also started in 1980. This device will enable dielectric constant measurements to be made at the temperatures and pressures expected during retorting. The dielectric constant measurements and the investigation of several potential methods of performing HFEM mapping will continue in 1981.

Supporting Research

At Rio Blanco, retorting models, developed by Lawrence Livermore National Laboratory, were tested during the retorting of the Retort O. Tracer testing of rubble piles and TV logging of bore holes and rubble pile surfaces were performed by LETC.

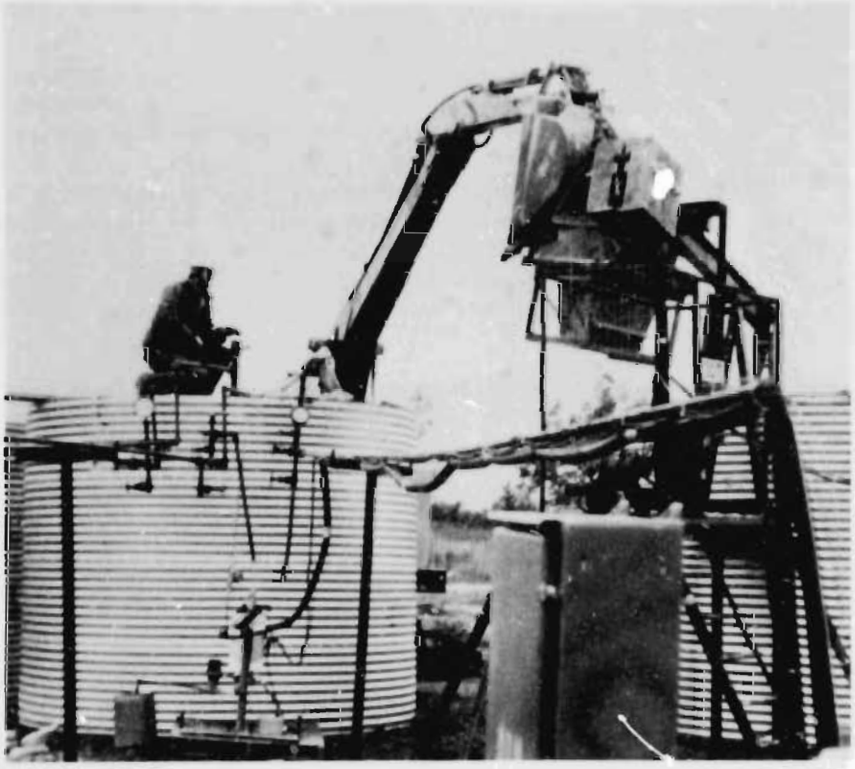
The Sandia National Laboratory accepted responsibility for full instrumentation of all experiments at the Occidental Logan Wash site. This includes the instrumentation for their mini-retorts, as well as for the full-sized Retorts 7 and 8. Sandia also did detailed planning for instrumentation and retorting of a small retort at the Geokinetics site.

Detailed environmental research plans were developed for the Occidental, Geokinetics, Rio Blanco, and Equity projects. These plans include the testing of environmental control methods and strategies for air and water, as well as testing elaborate sample acquisition methodologies.

The Anvil Points facility was brought back into the main stream of the oil shale research and development program with the move of the Los Alamos Scientific Laboratory rock fracturing experiments from the Colony mine to the Anvil Points mine. A detailed site rehabilitation plan was developed for the facility, and work was initiated to repair or replace major parts of the water system there. A plan to extinguish a fire in the shale pile was developed and initiated during the year. Extinguishing the fire requires moving a large portion of the pile. Approximately one-half to two-thirds of the affected pile was moved during the year.

A formal request to use part of the facility for an oil shale worker training program was made by the state of Colorado in the latter part of the year. Investigation of methods whereby this could be accomplished were initiated.

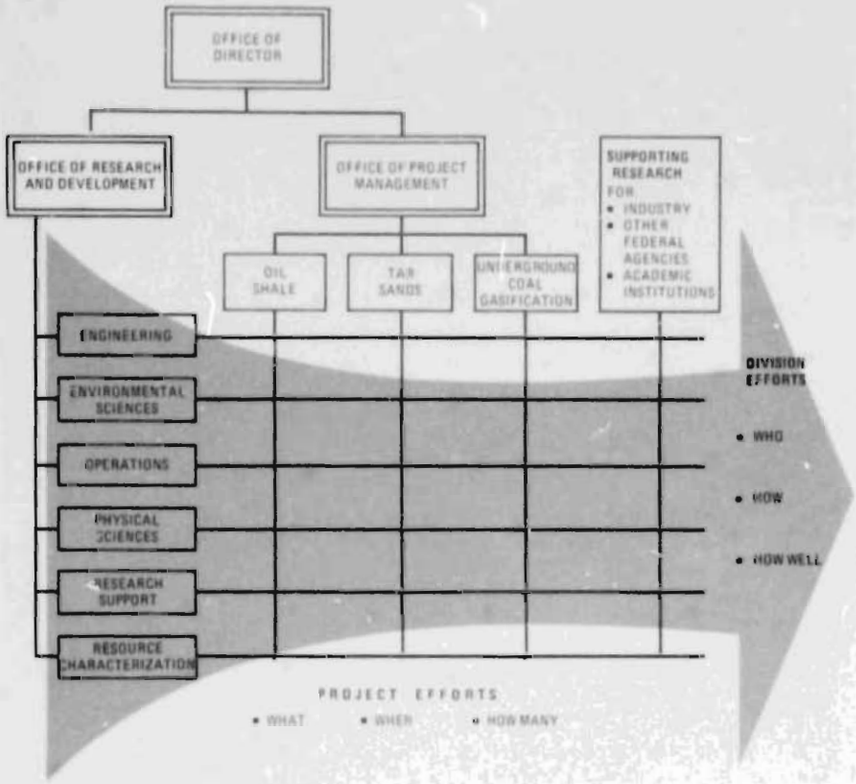
A new Program Opportunity Notice for the design of commercial-sized surface retorts was initiated. The Paraho and Superior companies were selected for the work. A Surface Oil Shale Demonstration Office was established to manage the contracts resulting from selections.



Corrugated steel safety barriers are set in place at a DOE-funded Dow Chemical oil shale test in Michigan.

RESEARCH & DEVELOPMENT

Jim Weber, Assistant Director
Janice Taylor, Secretary



Functional Summary

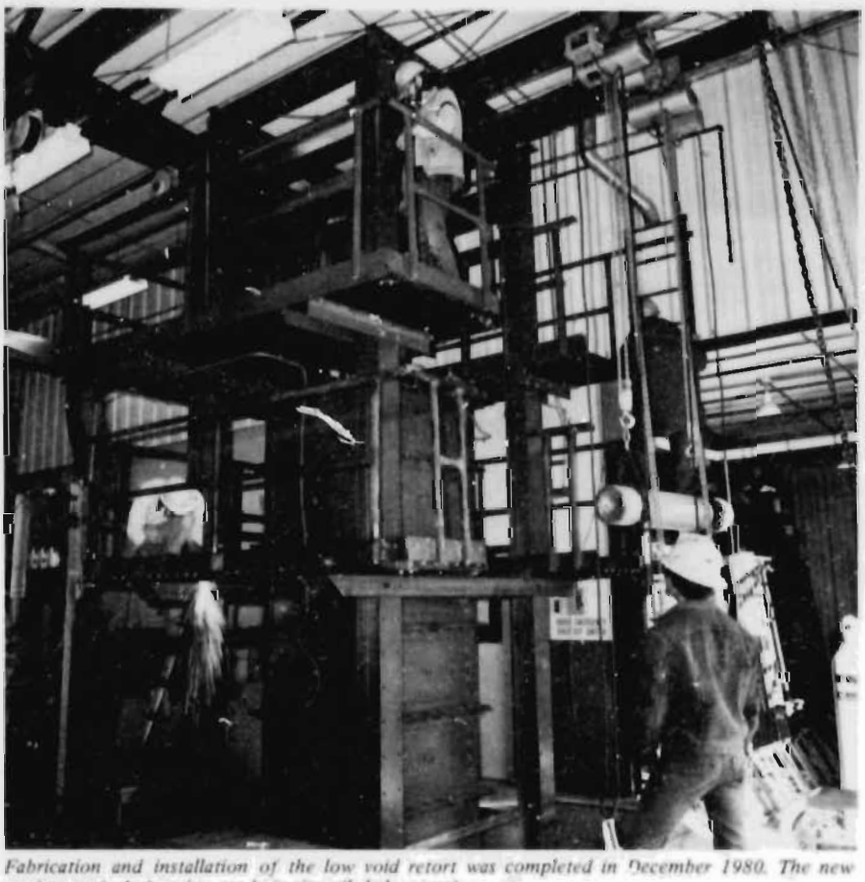
- **provides management and technical direction to six divisions**
- **maintains and develops LETC technology base**
- **provides technical expertise for project efforts**
- **directs and supervises functional side of Center Matrix**

The Office of Research and Development (ORD) is responsible for maintaining a strong technology base in oil shale, tar sand, underground coal conversion, advanced process technology, and fossil energy solid waste sampling, and for supporting LETC project activities under the Office of Project Management. This technology base is maintained by defining and developing areas for new initiatives, participating in the planning, execution, and review of lead center projects, continuing the development of LETC's expertise in fossil fuel technologies; and communicating technological developments through publications, presentations, committee activities, symposia chairmanships, and proposal reviews.

ORD consists of six functional divisions: Engineering, Environmental Sciences, Operations, Physical Sciences, Research Support, and Resource Characterization. ORD research projects support research and development in oil shale, tar sand, and underground coal conversion. A significant portion of ORD activity is carried out by area universities, including the University of Wyoming, the University of Colorado, Colorado State University, Colorado School of Mines, the University of Idaho, the University of New Mexico, and the University of Utah.

ENGINEERING

Bruce Sudduth, Division Manager
Rose Robinson, Division Secretary



Fabrication and installation of the low void retort was completed in December 1980. The new equipment is designed to study in situ oil shale retorting.

The technical details of preliminary designs for prototype commercial retort modules are being discussed by Bruce Sudduth, Norm Merriam, and Bob McLendon. Evaluation of the designs is being conducted in support of project management activities at the SOSD office in Denver.

Functional Summary

- **evaluates performance of fossil energy extraction, conversion, and upgrading processes**
- **determines technical feasibility and engineering methods for process scaleup**
- **defines and interprets reaction kinetics, fluid mechanics, and fracturing systems for in situ processing**
- **develops and applies mathematical models of process operations**

The Division of Engineering is responsible for processing systems to recover synthetic fuels from coal, oil shale, and tar sand. These responsibilities include definition, development, and evaluation of potential recovery technologies. Conversion and upgrading of synthetic fuel products are also evaluated as a part of overall processing requirements. Processing technology and expertise is developed through experimental projects in each of the five sections. Engineering teams are organized from these sections to apply process technology in support of major demonstration projects.

Fracture Technology

The Fracture Technology Section evaluates fragmentation and rubbling methods, which are used to prepare fossil energy resources for in situ processing. Oil shale mining and rubbling techniques have been evaluated in conjunction with field activities conducted by Occidental Oil Shale, Inc., Geokinetics, Inc., and Rio Blanco Oil Shale Company. Basic blasting data from experimental projects at Los Alamos Scientific Laboratory and Sandia Laboratories are used to evaluate the results of the field activities. Sub-

sidence associated with underground coal gasification is also evaluated through a contract with Ohio State University.

Chemical Kinetics/Fluid Dynamics

Chemical reactions and fluid flow distribution in fossil energy processing are defined by the Chemical Kinetics/ Fluid Dynamics Section. Basic data from laboratory experiments are used to develop mathematical models of process operations. The models are used for the prediction and evaluation of recovery system performance. This section also provides mathematical modeling expertise for Centerwide activities.

Laboratory experimentation focuses on a better definition of physical and chemical processes associated with oil shale retorting. Differential scanning calorimetry is used to identify endothermic mineral reactions at retorting temperatures. A new laboratory apparatus was constructed to investigate mechanisms for kerogen decomposition and oil degradation during oil shale retorting. Spent shale samples from these experiments will be analyzed with nuclear magnetic resonance techniques in the Division of Research Support to determine the nature of residual carbon from oil shale retorting. The formation of shale oil mist by convective heat transfer with oil shale rubble is being studied under a contract with the University of California, Berkeley. Mechanisms for mist deposition and drainage in rubble beds are also being investigated as a part of this contract.

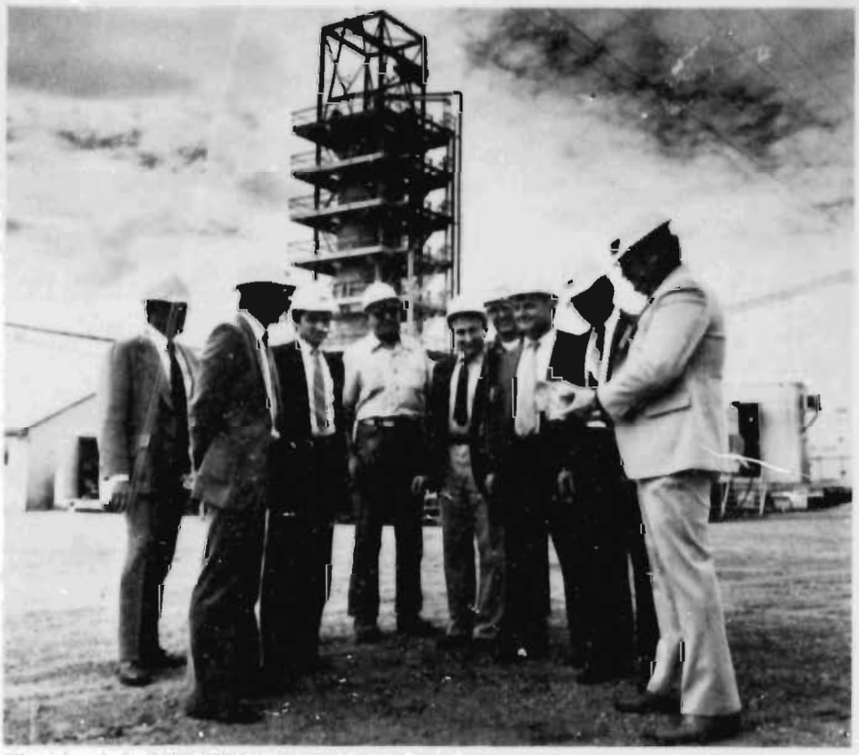
Well logs and tracer tests have been used to evaluate processing and rubbling performance at experimental field sites. Gas tracers are injected into the horizontal retorts at the Geokinetics field site near Vernal, Utah to evaluate flow distribution and leakage. Changes in flow distribution during oil shale retorting are also determined by tracer injection at the Occidental field site near Grand Junction, Colorado. Tracer tests are also used at the LETC tar sand field site near Vernal, Utah. Caliper logs and downhole television surveys have been used to evaluate rubble size and blast hole integrity during the preparation of Retort O at the C-a Lease Tract. As a result of these efforts, LETC has been requested to participate with Rio Blanco in the development of Retort 1 at Rio Blanco. These tests are scheduled to end in early 1981.

Mathematical modeling activities are principally conducted under contracts with universities and industry. The University of Wyoming was requested to provide modeling support for the LETC low void retorting project. The University of Wyoming is already under contract to provide mathematical models for reverse combustion linking and forward gasification in underground coal conversion. Modeling guidance for the design and operation of the first tar sand field test of a steam injection process has been provided under a contract with Intercomp Resource Development and Engineering, Inc. Observed temperatures in the monitoring wells at the tar sand test site have been simulated by assuming no vertical fluid flow and unsteady-state heat conduction through an infinite slab with a fixed temperature at the surface. These results, in combination with the tracer tests, have lead to an hypothesis of oil banking in advance of the steam front in the tar sand resource.

Process Diagnostics and Evaluation

Technical and economic feasibility of energy recovery technologies is evaluated by the Process Diagnostics and Evaluation Section. These evaluations include experimental activities to collect and interpret processing data. Engineering economic studies are used to define incentives for application of new process technologies. Opportunities for development of new fossil energy resources and improved recovery techniques are addressed in these efforts.

Horizontal oil shale gasification tests have been completed with both reverse and forward combustion. With reverse combustion, oil yields are generally less than 30 percent, and gas quality is disappointingly poor. The best gas quality of about 160 Btu/scf is achieved at low air injection rates. Gas quality also decreases with increasing pressure. With forward



The operation of the 150-ton retort and environmental control equipment is explained to visitors by Dick Martel, Dave Sheesley, and Andy Long. This retorting test involved the cooperation of several LETC divisions with complementary technical objectives.

combustion, retorting predominates rather than gasification. Oil yields as high as 83 percent of Fischer Assay have been achieved by adding 40 percent steam to the injection air. These experiments have not indicated sufficient benefits for continuation of horizontal oil shale gasification tests.

A new low void retort has been fabricated and delivered to LETC. This apparatus will enable the determination of minimum void conditions for in situ oil shale retorting. In these experiments, rectangular bricks of oil shale are stacked in a regular fashion. A new wire saw has been assembled and is operating to cut precise shapes of oil shale for spacers in the first retorting tests. These spacers facilitate uniform distribution of 8-15 percent void during the initial series of tests.

An arrangement with Los Alamos Scientific Laboratory has been developed to screen economic evaluations of alternative recovery processes. Base case economics of surface retorting, in combination with vertical modified in situ retorting, have been completed for several oil shale processing technologies. Other case studies have compared different process schemes for production of hydrogen from oil shale. These studies provide a basis for more detailed evaluations, such as a comparison of alternative injection gas compositions for the operation of modified in situ retorts. An evaluation of in situ combustion processing for tar sand recovery has been completed, and an economic comparison of applications for underground coal gasification is also underway.

Process Development

The Process Development Section conducts pilot-scale experiments and operates field tests to determine control strategies for synthetic fuel production. Process performance and operating conditions are then compared with the mathematical model predictions. These experiments provide data for projection of commercial production economics.

The retorting equipment at the LETC North Site was reconditioned for future test programs. Refurbishment of the 10-ton retorting system followed completion of tests with the Michigan Antrim shale. The product recovery system was disassembled to inspect for corrosion and to remove sulfur deposits. Repairs and replacements were completed as necessary. The 150-ton retorting equipment was modified to include provisions for incorporating pollution control equipment in the product recovery system. An initial test of environmental control technologies was conducted in cooperation with the Division of Environmental Sciences and the Environmental Protection Agency.

Process development engineers participated with the Tar Sand Project in the completion of the first LETC field experiment to test tar sand recovery with a steam injection process. The field test was designed as 2 concentric 5-spot well patterns to recovery bitumen from a 45-foot sandstone interval in the Rimrock member of the Mesaverde formation near Vernal, Utah. Oil production of 1,150 barrels accounted for 5.7 percent recovery of the resource during 160 days of operation. Steam injection at 72 percent quality was equivalent to about 66,800 barrels of water. The steam was injected at rates of 250-700 barrels per day and 360-530 psig.

Product Conversion/Upgrading

The Product Conversion/Upgrading Section determines processing requirements to substitute synthetic crude oils for petroleum in conventional refineries. Processing schemes are evaluated for blending synthetic crudes with petroleum to meet refinery specifications for feedstock quality.

Blends of Geokinetics shale oil with Altamont petroleum crude have been examined for stability of distillate fractions. A mixture with as little as 2 percent shale oil darkens by oxidation even when the distillate is refrigerated. Gum formation is rapid when the mixture is exposed to air and sunlight at room temperature. These tests indicate the need for shale oil upgrading before blending with local refinery feedstocks.

Samples of hydrotreated shale oils were prepared to determine stability of blended refinery feedstocks for different levels of denitrification. Several gallons of hydrotreated product were prepared at other nitrogen levels up to 10,000 ppm. Comparable samples of Occidental and Geokinetics shale oil were also prepared. Portions of these samples were shipped to Southwest Research Institute for stability tests.

ENVIRONMENTAL SCIENCES

Richard Poulson, Division Manager
Marjorie Rinehart, Division Secretary

LETC personnel from the Divisions of Engineering, Operations, and Environmental Sciences viewing scrubber samples from the 150-ton retort burn September 1980. Materials in the product gas were transferred to water, and the water was treated and recycled to the research experiment.

Functional Summary

- **develops, reviews, and evaluates environmental impacts of Center-related technologies**
- **develops lab, bench, and pilot scale experiments to test waste control and waste use process concepts**

The Division of Environmental Sciences is responsible for the environmental efforts associated with LETC's oil shale, coal, and tar sand projects. In addition, it is responsible for developing an environmental monitoring and control technology data base to promote the environmental acceptability of fossil fuel processing technologies. The division works closely with the Office of Environment and Conservation and the project offices to insure that LETC field projects are conducted in an environmentally acceptable manner and in accordance with all applicable regulations and standards. The division also maintains a core effort directed at determining and resolving environmental issues associated with oil shale, coal, and tar sand processing technologies.

The overall strategy for conducting environmental work is based on a concept of continuous cycles. Such cycles involve planning, research and development, implementation of environmental controls, and review of accomplishments. The driving force in the cycle is the changing demand for energy. The cycle begins in the laboratory, and pilot-scale research works through increasingly

involved field activities, and, ultimately, moves to full-scale demonstration and commercial-scale operations.

The simultaneous accomplishment of process development with environmentally acceptable work is a significant aspect of division strategy. Because field experiments offer the best opportunities for determining and resolving potential environmental problems related to fossil fuel processing, the Division works closely with other LETC staff members in the planning and coordination of field acitivities.

The principal technical efforts are in the design and implementation of monitoring and mitigation systems for aqueous, gaseous, and solid wastes; safety and health; environmental information storage and retrieval; and project support.

View to the northeast of the Anvil Points retorting facility. The new disposal site for hot shale contains about 30,000 tons of shale. An equal quantity of shale must still be moved to complete extinguishment of the smoldering in the disposal site.

Aqueous Effluents

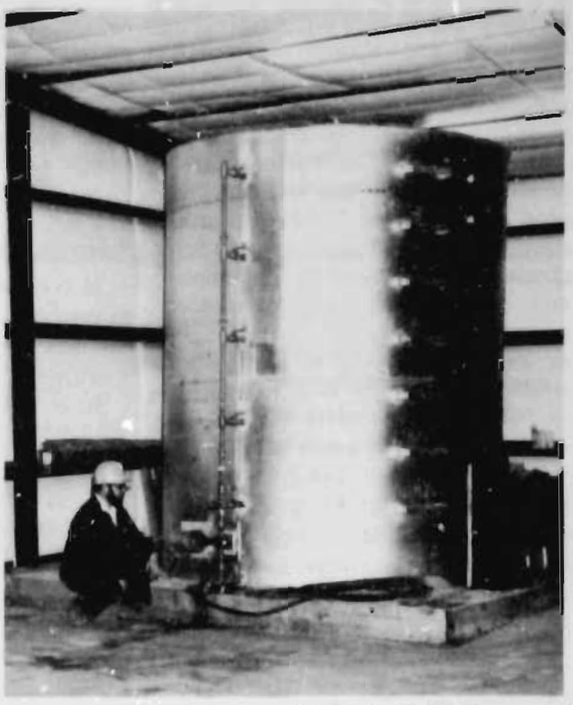
In 1979, the Division of Environmental Sciences established a program for collection, processing, and storage of water samples from in situ fossil fuel field demonstration studies. This program provides multidisciplinary research teams with a source of these sample waters for chemical, biological, and toxicological characterization, as well as treatability studies. Samples include groundwaters, process waters, and partially treated wastewaters.

Sample history, analyses, and disposition are maintained on the Environmental Data Information System (EDIS) computer. In addition, environmental technical activities are kept current in this system.

To insure sample integrity during extended storage, a Refrigerated Research Sample Repository (RRSR) was established. Subsequent to collection at the field site, all sample preparations, storage, and disbursements are made from the RRSR. The facility currently contains 48,000 gallons of homogeneous process waters collected from 15 field locations. Major efforts were continued using these waters to determine their potential environmental impacts, and to develop water treatment processes.

In 1980, approximately 110 sample disbursements, totaling 1,800 gallons, were made from the RRSR. These samples are currently being used for the following types of research studies:

- Phytotoxicity and plant response
- Animal bioassay and mutagenicity



Large samples from field operations are collected in drums in the Refrigerated Research Sample Repository (RRSR). Composite samples are then stored in the large tank at the right and distributed to qualified researchers for environmental studies.

- Animal toxicity
- Toxic effects on aquatic species
- Inorganic and organic analyses
- Analytical method verification
- Control technology

The Environmental Sciences Division has developed test procedures for determining biological responses to fossil fuel process related waters. Such protocols will guide the development of control technology options.

The availability of the various water samples and the test procedures allowed this program to begin a new direction in 1980; namely, to determine the range of biological responses and physical and chemical properties associated with the many types of water encountered by in situ technologies.

Significant accomplishments were made in research and development efforts related to treatment of wastewaters produced during oil shale processing. The major types, qualities, and quantities of water streams expected with commercial-scale oil shale retorting have been estimated. As a result, the types and degrees of suitable treatment have broadened. Active research in water treatment has established the feasibility of ammonia removal from retort waters as an efficient primary treatment step for purification of moderately low-quality process waters. These techniques were used on site to back up the Venturi scrubber experiments described in the Gaseous Effluents section.

In situ fossil fuel recovery sites operated by LETC were assessed for monitoring and mitigation requirements prior to site closing. Plans for monitoring research have been made to acquire data and to develop compliance requirements.

Gaseous Effluents

During 1980, the Division of Environmental Sciences entered into a cooperative experimental research effort with the EPA at the LETC North Site 150-ton retort. The primary purpose of the cooperative effort was to measure the performance of control technology equipment for removal of particulated from simulated in situ oil shale retort off-gases. Four other important objectives were also achieved by the experiment. These are:

- Operational familarity to the testing personnel
- Engineering design data for upgrading process configurations
- Water treatment concepts required to obtain scrubber water cleaning data
- On-line air and water characterizations for treatment of control media

This study characterized Venturi scrubber performance and identified field variables as a function of modifications to scrubber operational parameters for reducing the volume of scrubber water for disposal. This test also provided impetus for additional research to evaluate the performance of air and water control technologies using a complete recycle of treated effluents, thereby minimizing residual contaminant production and release. Overall, this experiment further confirmed the value of the 150-ton retort for assessing control technology equipment design and operational parameters under field conditions prior to implementation at commercialized sites.

Solid/Hazardous Wastes

Oil shale processes and research generate solid wastes, some of which are

hazardous. Both the Process/Project Monitoring and Control Technology Sections of the Environmental Sciences Division function to identify, assess, and implement controls for air and water borne contaminants that may be released to the environment due to laboratory, pilot, demonstrations, or during commercializations of fossil fuel energy resources. Control of such by-products is implemented by changing the transport phase concentration, and often the form, to an inert manageable solid. As a result, research projects are being conducted to evaluate adequate waste characterization and safe disposal concepts.

Hazardous waste management plans have been drafted for LETC waste generating activities, and are in the formalization stage. Plan development responds to the Resource Conservation and Recovery Act and hazardous waste regulations of the EPA for inventory and control of the generation, safe storage, transport, and disposal of hazardous materials. The Division of Environmental Sciences is responsible for plan development and implementation, with input and assistance of members from each division of the Office of Research and Development. The final report for management review will be an interdisciplinary effort by LETC scientists and engineers, in conformity with regulations and responsive to each division's specific waste disposal requirements.

Safety and Health

In conjunction with the LETC Safety Manager, Center laboratories and field sites are being examined from an industrial hygiene standpoint.

In order to identify health and safety areas which must be addressed in the demonstration phase of what ultimately will result in commercial-scale oil shale facilities, a "Preliminary Logic Flow Analysis for Health and Safety" flowchart was developed. This flow-chart identifies the health and safety tasks critical to a successful effort, including health and safety compliance, biological effects, and epidemiology studies.

Information

In order to meet the demands of in-house and contractual research, a computerized management information system was developed and instituted in 1979. This system, known as the Environmental Data Information System, performs inventory, tracking, planning, and data storage and retrieval. It also reports functions pertaining to objectives, tasks, schedules, obligated funds, events, logs, reports, and publications associated with each division activity. The success of this system has encouraged modifications to meet similar needs throughout the Center.

An effluent inventory has been prepared for all LETC fossil-fuel recovery projects. Water quality data are stored in the data system described, or in the University of Wyoming computer.

Project Support

The Environmental Sciences Division, along with the Office of Environment and Conservation, provides environmental support to the technical project officers in DOE/industry cooperative agreements, and to project managers for in-house projects. Environmental monitoring and mitigation plans spell out monitoring networks and methods to be used in detecting potential environmental impacts from a project and mitigation measures to be taken in correcting adverse effects.

OPERATIONS

Terry Brown, Division Manager
Shirley Augustin, Division Secretary

As the first step toward acquiring new modern lab facilities, LETC completed the conceptual design for the new laboratory depicted in this artist concept.

In front of the Division of Operation's air service display board, Debbie Arnold and Terry Brown review a weekly flight schedule.

Functional Summary

- occupational health and safety
- security and emergency preparedness
- engineering design and construction management
- mechanical design and fabrication
- government property management
- field project and North Site support
- energy management
- facilities, maintenance, and modification
- visual materials file maintenance
- presentation and publication support
- photography, video and audio-visual production
- exhibit development and management
- motor pool and heavy equipment management
- travel and transportation coordination

The Division of Operations renders fundamental support for all divisions and project activities at the Center. This division provides a diverse set of support services for the specialized research, development, and management expertise of the Center. By providing these support services, the Division of Operations makes a significant contribution in LETC's oil shale, tar sand, and underground coal conversion research, development, and resource management.

The fucntional areas of the Division of Operations include: safety and security, design services, property management, construction management, field operations, energy conservation, facilities, graphics, audio-visual, motor pool, and travel.

Safety and Security

The Center obligated more than $500,000 during 1980 on safety improve-

ments, including construction of a chemical storage room, upgrading of sample storage and retort piping, and providing an off-site bulk solvent storage facility. The safety manager was assigned a key safety and health role in cooperative project technical management. A research chemist from the Division of Research Support was matrixed to develop an industrial hygiene program, conduct field monitoring, and identify other safety and health requirements. The LETC Safety Council and the Laboratory Safety Committee have been directly involved in the review, development, and implementation of safety policy procedures. A detailed Safety Analysis and Review of the TS-1S tar sand project was completed.

Safety and health training courses were conducted in: first aid, respirator breathing techniques, forklift operation, fire extinguisher use, chemical safety, and handling hazardous chemicals. Approximately 300 DOE and contractor employees participated.

A comprehensive security program was implemented. This program included 24-hour access control, uniform guard service, night patrols to outlying facilities, and a property pass system. Security improvements valued at more than $80,000 were completed. Periodic security awareness briefings were conducted for all Center employees and training for the Emergency Planning Preparedness and Response Plan was conducted.

Brenda Manuelito and Elden Almendares enter property management data into the Division of Operation's new data access system. Property Management was added to the list of support services provided by this Division in 1980 for the Center.

Design Services

1980 was a year of accomplishment for the personnel of the Design Services. Many long hours of planning, designing, drawing, and coordinating have resulted in completion – from conceptualization through final construction – of many projects, including: renovation and modernization of the control systems for the three main steam boilers, installation of new roof surfaces, and construction of an additional parking area. In addition to the completed projects, construction is progressing rapidly on window repair and storm window installation on the main building and the annex, North Site gasification building expansion, stockroom relocation and office conversion, main building lobby modification, and a security fence for the North Site. Although general plant projects constituted the bulk of the workload for the past year, the personnel of the Design Services Section coordinated the TS-1S engineering design, monitored construction for this tar sand experiment, and modified the design for the low-void reactor at the North Site gasification building.

An essential element of the Design Services Section is the machine shop, where laboratory devices are repaired, experimental equipment is fabricated, and, in general, everything from precision glassware to massive steel pipe components is machined.

A graphics services contract was developed to provide for more rapid response of all graphics support requirements which are over and above the available in-house capabilities. Color slide production and an illustration filing system are two additional presentation support services now offered by this section.

Larry Douglass adjusts a flow rate on the newly rebuilt 10-ton retort piping system. The tanks shown are essential components of the 10-ton's oil recovery system.

Property Management

In September, the Property Management position was filled, and, since that time, the inventory management specialist and LETC computer personnel developed and implemented a property management computer system.

The LETC Property Management policies and procedures handbook is in the draft stage with the implementation date targeted for September of 1981.

Preliminary plans were prepared for the inventory of all government property at Anvil Points, Geokinetics, and LETC oil shale and UCG sites.

Construction Management

The Construction Management function continued its long-range facility planning and general plant project activities throughout 1980. However, the activity was considerably reduced because there was no full-time engineer in the position. A preliminary conceptual design was completed for the new LETC laboratory facility and was submitted to DOE Headquarters for the Fiscal Year 1982 budget. Seven general plant projects were completed in 1980 and eight have been funded for 1981.

Field Operations

Field Operations provided manpower and equipment support to the LETC TS-1S project during construction and operation of that test in 1980. Deactivation of the Rock Springs and Hanna sites continued during 1980, with most of the equipment and materials being transported to Laramie for storage or use on other projects. Work will continue on these sites in preparation for site restoration, which is scheduled to commence in 1981.

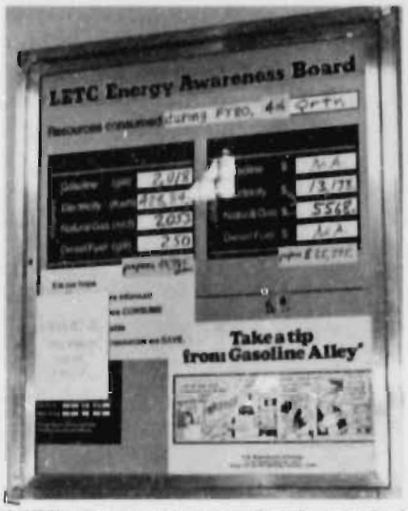
Field Operations personnel also provided manpower, equipment, and operating expertise for operation of the 10-ton and 150-ton retorts at LETC's North Site. In addition to normal maintenance on the retorts, Field Operations personnel completed major repiping, cleaning, inspection, and hydrostatic testing on the 10-ton retort to upgrade the facility to comply with current safety standards. Field Operation personnel prepared and operated a 150-Ton retort test program in conjunction with DRI, Monsanto, EPA, and LETC personnel.

Field Operations personnel also completed numerous work requests submitted by other divisions and supported other sections in the Division of Operations.

Energy Conservation

A 10-Year Energy Management Plan was submitted to DOE Headquarters. The major components of the plan include anticipated gasoline, electricity, natural gas, diesel fuel, and propane usage in the next 10 years, with estimated cost savings. Emergency building temperature restrictions will continue to be in effect until October 1981.

A 1980 Annual Report on Energy Conservation was also submitted. This report furnished information on van pooling, ride sharing programs, and alternate fuels such as gasohol and propane conservation on gasoline-powered vehicles and equipment.



LETC's Energy Awareness Board, conceived and developed by the Energy Management Committee, reminds viewers to be conscious of the use and costs of nonrenewable energy supplies.

Facilities

The Facilities Section maintained 24-hour a day, seven days a week, operation of LETC's offices and laboratories. This team effort included plumbing and electrical maintenance, carpentry repairs, boiler modifications, and several major office modifications. Increased staff and evolving responsibilities resulted in many relocated and remodeled offices. This section accomplished these difficult tasks on short notice and with minimal disruption to ongoing Center functions.

Graphics

In 1980, the graphics efforts within

Frank Moore conducts first-hand inspection on work in progress for a new roof on the Administration Building's Northeast Wing.

the division's Operational Support and Property Management Section focused primarily upon increasing involvement and activity in the publications and exhibit production.

LETC was asked to use its Oil Shale Exhibit to support DOE's public meetings on oil shale in Denver and Grand Junction, Colorado, last spring. Portions of the exhibit, with some new conservation-oriented material, were set up for Laramie's Chamber of Commerce at their Fourth Annual Energy Conservation Fair. This year also saw more formal involvement with the Government Printing Office and presentation support at an earlier, conceptual level.

Audio-Visual

During 1980, LETC Audio-Visual services contributed a variety of presentation materials to individuals responsible for key information on the Center's role in DOE. Significantly, the Center's expanding role resulted in greater effort in preparing briefing materials for visitors from government and industry.

Slide and videotape presentation production is now contracted, storage and retrieval are more centralized, and dissemination of information is more streamlined.

Audio-Visual services continues the coordination of photodocumentary input for the DOE energy technology visuals collection. The Center's responsibility for this effort extends to a six-state area. This collection is extensive, providing photography and computer-generated data sheets to all DOE program directors, Congressional liaison personnel, and public relations offices throughout government and industry.

Motor Pool and Mobile Equipment

1980 was another year for energy conservation and energy reduction. DOE extended and generated numerous new energy-reduction requirements on all of its functions. This directive required LETC's Motor Pool to reduce gasoline consumption by 10 percent, and new economy requirements for sedans, station wagons, and light trucks were issued. By the fourth quarter of Fiscal Year 1980, LETC reduced gasoline consumption by 41 percent, well exceeding the 10 percent requirement.

Travel

With LETC's increasing activities, responsibilities and programs, the Travel Office also experienced an increase in its activities.

In April, travel restrictions were imposed by DOE Headquarters and new reporting procedures were established. However, in October, the travel restrictions were lifted and the Travel office resumed its normally busy schedule.

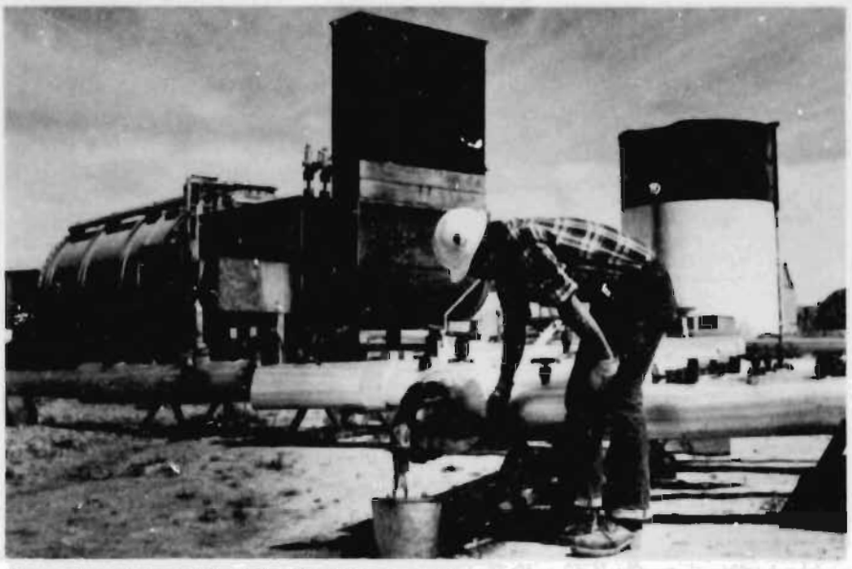
The air service contract continued to be a vital part of the Center's efficient and safe travel program. It logged a total of 346 hours and provided the Center a savings of $20,334 for 1980 over commercial services. The many trips to the Center's field sites and offices at Vernal, Rifle, Grand Junction, and Denver were handled efficiently in less than 10 hours by use of twin-engine or single-engine aircraft. In most cases, travel to the remote field sites would entail two to three days by commercial airline flights and/or ground transportation.

Jack Rollison discusses with Andy Long the kerogen content of oil shale and other details pertinent to writing script for a videotape briefing.

During 1980, LETC was able to meet and exceed its energy conservation goals in the transportation fuels category. In part, this was possible because the motor pool returned several vehicles like these on the left, trading them for vehicles like those to the right.

PHYSICAL SCIENCES

Sam Dorrence, Division Manager
Rosemary McCabe, Division Secretary



Frequently, professionals in the Process Research Section conduct their R&D at LETC field sites. Ken Thomas is collecting a sample of the water-oil emulsion produced during the in situ steam-flood experiment at the tar sands site near Vernal, Utah.

John McKay of the Chemistry Section is shown operating a Fourier transform infrared spectrophotometer. This device is capable of analyzing chemical components in gases, liquids, and solids.

Functional Summary

- **analyzes fossil fuel recovery, processing, and utilization methods**
- **develops processing techniques for fossil fuel recovery**
- **provides basic chemical research for fossil fuel characterization**
- **develops or improves potential uses of fossil fuel products**

During 1980, the Divison of Physical Sciences experienced some significant changes. Several employees retired or resigned, and the increasing demands for expertise in the physical sciences necessitated reassignments of division personnel in order to use talents more effectively. Several potentially useful research projects were deemphasized or abandoned in order to focus resources on higher priority projects. Division employees are demonstrating their adaptability by their current, productive efforts in support of DOE programs.

The division performs research dealing with recovery, characterization, separation, and determination of properties and potential uses of fossil fuel hydrocarbons. The division has primary responsibility for LETC activities related to the Advanced Process Technology (APT) program. It also supplies expertise in the physical sciences in support of oil shale, tar sand, and underground coal conversion programs with various matrix-management assignments.

Professionals in the division published 10 scientific articles, gave 29 technical presentations, and held eight offices in scientific societies during 1980.

Process Research Section

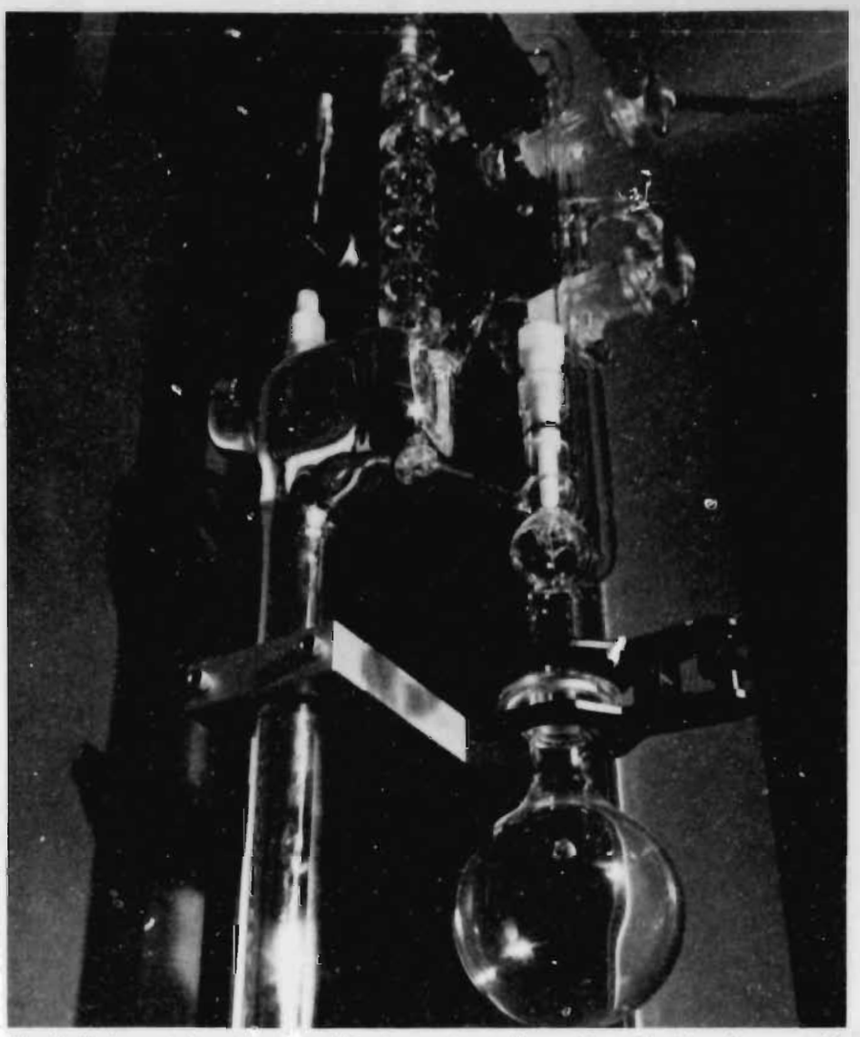
The Process Research Section participates and assists in field and laboratory

recovery efforts by obtaining information on products and raw materials, with emphasis on how data relate to recovery and processing parameters. Planning, design, conduct, and evaluation of recovery experiments are ongoing processes. Products are evaluated with regard to need for upgrading before conventional processing.

Extensive resources were devoted to LETC's first field steam recovery experiment in tar sand. Time was spent in planning, designing, constructing, and conducting the TS-1S experiment. Prior to field work, product mixture demulsification techniques were screened and a successful approach was developed for this serious problem. To demonstrate the applicability of this work, much of the product oil from the recovery experiment was reduced sufficiently in water and mineral content so that it was used to fire the steam generator used during the experiment. A chemistry laboratory, set up on site, attended to problems and also gathered and processed water and oil samples and tested various process waters used on site. Water and oil samples collected during TS-1S are currently being processed, analyzed, and evaluated in Process Research laboratories. Two university research contracts are supporting this section's tar sand research.

Oil shale projects were supported in several ways. One ongoing study attempts to relate physical properties of recovered shale oils to processing parameters. Oils have been prepared under carefully controlled laboratory conditions for the initial phases of this study. Computerized treatment of extensive physical property data indicates that one or two properties may be strong indicators of the processing parameters experienced by the oil. This method could be particularly useful for in situ-produced oils, to predict process conditions at any given time so that adjustments can be made if required or possible. Two university research contracts support this effort.

Shale oils and fractions are notorious for gum formation and discoloration on standing, especially in contact with air. Organic nitrogen compounds have been shown to be at least partially responsible. During 1980, a continuing study of shale oils and distillates indicated the percentage and types of nitrogen compounds that are initially present in several shale oils. The study also determined to what extent the nitrogen types are decreased during hydrotreatment. Although all nitrogen compound types are reduced, some types were shown to survive hydrotreatment more readily than others.



The distillation unit shown here is capable of separating small quantities of liquids under very stable, reproducible conditions.

Support for DOE's underground coal conversion program was limited this year by budget constraints. However, two section personnel continue to be involved with LETC's underground coal gasification project. Organic liquid products and produced waters were collected during Hanna IVB, and they are being analyzed and evaluated. In particular, the organics may be very valuable as a byproduct of UCG. These liquids are high in contents of hydrocarbons. Other work included participation in LETC team efforts to evaluate results and data from the Hanna IV experiment.

Other section research efforts included: (1) work with several other LETC professionals to determine the structure of organics in oil shale that were not previously identified, and (2) studies of organic and inorganic constituents in black trona waters and use of these waters to recover bitumen from tar sand.

Chemistry Section

Research is being conducted to investigate innovative recovery techniques for fossil fuels and to develop analytical

methods for obtaining composition and property data on high-boiling distillates and residues of fossil fuels. The goal of the research speaks to the need for complete, efficient utilization of all fossil fuels.

New methods are being explored for converting oil shale to usable fossil fuel products. The purpose of the research is to develop methods that are more energy efficient than current methods.

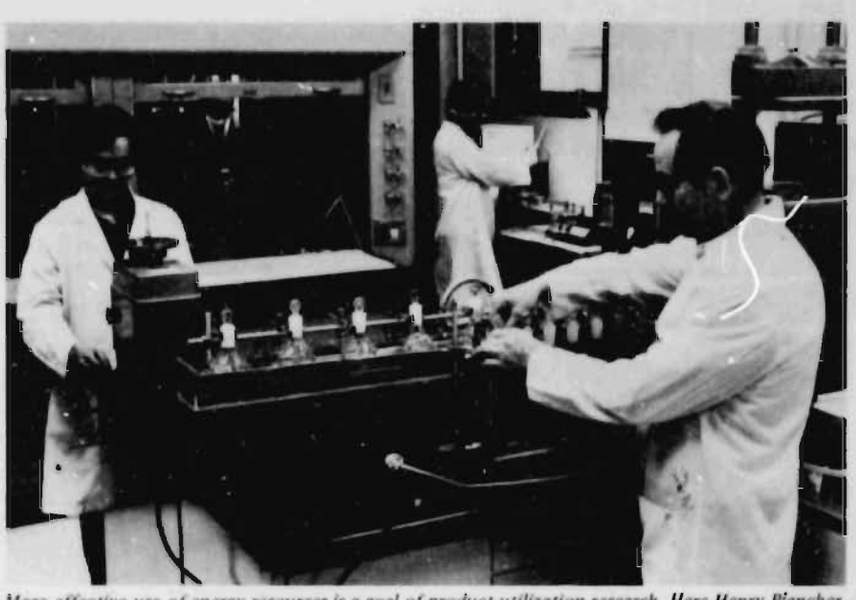
Dense-fluid extraction of oil shale, using water, gases, and solvents in various combinations, produced yields of organic material similar to Fischer assay yields but at temperatures about 100°C lower than normal retorting methods.

Reflux temperature extraction studies using organic solvent mixtures showed that the amount of organic materials extracted from raw shale increased as solvent strength increased. Carboxylic acids and carboxylic acid salts are major compound types extracted.

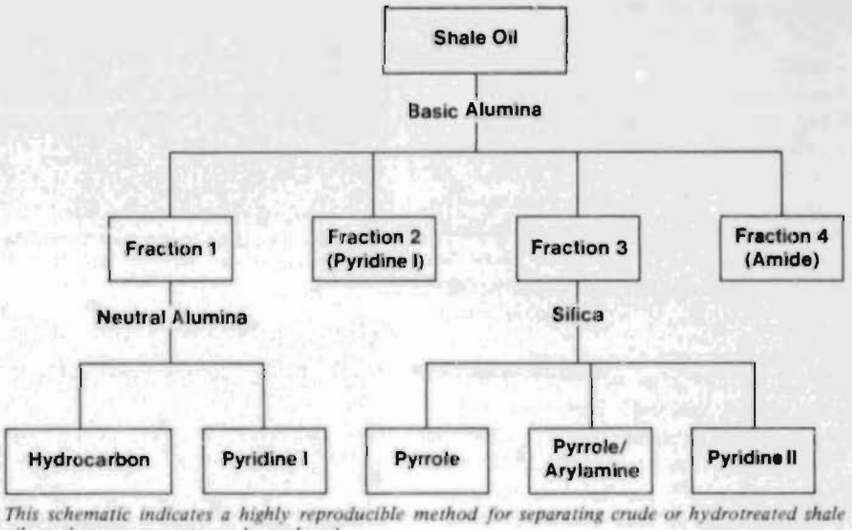
Changes in mineral composition of Green River shale that occur during shale oil recovery experiments are being studied by X-ray diffraction analyses. The experiments demonstrate that major changes occur in the inorganic composition of the shale at temperatures between 300 and 400°C and that water plays a major role in the decomposition.

Research is continuing on the characterization of the organic and inorganic materials produced in recovery experiments. By further understanding the complex chemical and physical mechanisms that take place during the recovery experiments, it may be possible to develop new methods for converting oil shale to usable fossil fuel products.

A separation-characterization method previously developed by this project for heavy petroleum fractions was adapted and applied to high-boiling shale oil distillates and residues. A new method was developed to separate the hydrocarbon portion of heavy shale oil samples into saturate, olefin, and aromatic fractions. A method was developed for determination of the acid compounds in which shale oil samples are separated by chromatography and the resulting subfractions analyzed by infrared spectroscopy to determine the types and amounts of compounds present. A study was made of residues from shale oils produced by four retorting processes to obtain data on the composition of these materials and relate that composition to the retorting process.



More effective use of energy resources is a goal of product utilization research. Here Henry Plancher, George Miyake, and Chee Kin Chow of the Product Utilization Section explore the possible use of high nitrogen content by-products.



This schematic indicates a highly reproducible method for separating crude or hydrotreated shale oils so that components can be analyzed.

Product Utilization Section

Product utilization research focused on continued development of chemical composition, reactivity, and performance-related data needed for more effective utilization of high-boiling and residual products and byproducts from fossil fuel production. Over 3 percent of the fuel equivalent of crude oil fed to U.S. refineries is used in essential non-fuel uses such as asphalt. Increasing pressures to convert more heavy materials to liquid fuels to meet the nation's energy needs threatens both asphalt quality and supply. Concern is growing, particularly among asphalt users, that recent variabilities in crude oil supplies are responsible for an apparent recent increase in asphalt performance problems. Looking to the future, the impending emergence of a synfuels industry necessitates the

investigation of high-boiling and residual products from synfuel sources as replacements for conventional petroleum counterparts. Thus, new and challenging problems needing resolution continue to emerge related to the use of our fossil fuel resources in the construction, maintenance, and recycling of the nation's roadways.

Research on factors affecting the performance of new and changing products in pavement applications was expanded by the initiation of several university research studies and by a Fulbright-Hays scholar from Pakistan whose investigations further defined the chemistry of asphalt oxidative aging.

In applied studies, experimental asphalt pavement binders and modifiers from tar sand and shale oil were shown to produce pavement mixtures with resistance to water damage superior to that of petroleum-produced asphalt pavements. A fuel-undesirable, high-nitrogen by-product from the experimental refining of shale oil was particularly effective.

To provide for technology transfer, close liaison and collaboration was maintained with asphalt technologists from Federal and state highway agencies, universities, and other peer groups. Recognition of division expertise in asphalt-related chemistry and technology was evidenced by their invited participation in external project peer review panels and ad hoc teams to resolve pressing asphalt performance problems. Division personnel actively participated on many national committees and task forces related to asphalt technology, including those of the National Research Council and the American Society for Testing Materials.

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RESEARCH SUPPORT

Larry Jackson, Division Manager
Andrea Reeve, Division Secretary

Don Netzel and Fran Miknis discuss the method of calculating oil yields from solid state NMR data. Solid and liquid shale oil data obtained from NMR testing provide chemical information about oil shale retorting processes.

Ken Jackson performing elemental analysis on shale oils with an ICAP spectrophotometer. The results of this type of work are used to develop a high quality data base describing fossil energy-related materials.

Functional Summary

- **prepares and separates fossil fuel samples**
- **provides chemical and physical analyses**
- **develops monitoring and evaluating instrumentation for field projects**

The Division of Research Support provides scientific and technical expertise in chemical, physical, and spectroscopic analyses, and computer science, data acquisition, and process control instrumentation. The division's activities focus primarily on support of laboratory and field experiments related to tar sand, oil shale, and coal through management information systems for the Center. The Division is comprised of four sections: Advanced Methods, Computer Research Applications, Spectroscopic Methods, and General Analysis.

Advanced Methods

The Advanced Methods Section is responsible for initiating state-of-the-art methods of analysis and time-saving measurements, and for providing information not obtainable by conventional methods to Center projects.

During the year, instrumentation and data acquisition and maintenance support were provided for engineering experiments conducted at the North Site Retorting and Gasification Facility (located one mile north of Laramie) and for the LETC TS-1S in situ tar sand experiment near Vernal, Utah. This support involved the placement of downhole thermocouples in the tar sand formation to monitor temperature changes during the experiment, placement of flow meters to monitor steam injection and liquid products, and pressure transducers to monitor

wellhead pressures. The hardware and software necessary for these experiments was also provided to the project staff.

Section personnel also contributed to projects involving the development of instrumentation for tracer testing and for well logging at in situ oil shale projects in Colorado.

Work continued on the development of solid state nuclear magnetic resonance (NMR) techniques for the study of the dynamics of oil shale retorting and for oil shale resource evaluation. This work was conducted at Colorado State University, with technical project direction and funding from LETC. A prototype variable temperature NMR probe for oil shales has been constructed.

The NMR spectra provide information about the organic carbon distribution in oil shales – specifically, what fractions of the organic carbon have aliphatic or aromatic chemical structure. When an oil shale is retorted, the aliphatic carbon structures are largely responsible for producing shale oils, while the aromatic structures largely produce residual carbon. From the NMR spectra, it is possible then to predict how much shale oil will be produced and how much residual carbon will remain after retorting. A knowledge of the residual carbon is important in oil shale retorting because the residual carbon is burned to supply energy for the retorting process. The NMR spectra illustrated shows that for the same amount of organic matter in the oil shale, the Colorado oil shale will produce more shale oil than the Moroccan oil shale, which in turn will produce more shale oil than the Kentucky oil shale. The correlation of this type of NMR data with the classical Fisher Assay Oil Yield is one to one.

Also, during 1980, section personnel taught a course in "Communications Theory" at the University of Wyoming's Department of Electrical Engineering.

Computer Research Applications

1980 was a development period for this section, which provides software, hardware, and consultation for Center divisions and projects. A new computer system was accepted on January 18, 1980. As a result, the entire period was spent on a major technical redesign of the Center's earlier Financial Management System (FMS).

The systems analysis, programming, and system design of the Center's new FMS was carried out under the leadership of section personnel. A direct result of this year's effort is the new FMS currently in place at LETC. The FMS system consists of travel, requisitions, salaries, contracts, budget, and summary data bases. Each application assures that all areas of financial management are integrated into the budget plan, beginning at the overall LETC level and ending at the individual task level.

All program systems have the capability of hardcopy reports on a daily, weekly, biweekly, or "as required" basis.

Property management activities have been placed on the new computer system with inquiry status availability.

During 1980, LETC has made additional advances in both physical and software computer security. Physical intrusion prevention devices have been installed. A new software security application, compatible with the administrative computer system, was required to monitor and control the anticipated number and variety of system users via CRT terminal. The protection of LETC assets through hardware, software, and data base security procedures are in keeping with the increased emphasis of computer security. A graphics enhancement package was also purchased.

General Analysis

The General Analysis Section provides analytical chemistry support to groups within the Center, and maintains an environmental and process monitoring group which supports Center field activities. The analytical chemistry group offers over 180 separate chemical analyses for ambient atmospheres, process gas streams, ground and process waters, raw and processed fossil fuel sources, and gaseous, liquid, and solid fossil fuel products. During 1980, the section received 10,003 requests for analyses, resulting in 27,346 determinations. A computerized Sample Information Management System (SIMS) has been installed and is maintaining surveillance on samples, analyses scheduling, assemblying and preparing reports, and maintaining a dynamic computer record of all analyses for future reference. These analytical services and archival data records aid all technical projects within the Center, and are used to provide critical information on major DOE/industry efforts, most notably the Program Opportunity Notices under LETC's technical supervision.

During the past year, analyses of hydrocarbon products were done to aid the shale oil processing project in evaluating the efficiency of various upgrading processes. Numerous water samples were analyzed for data to evaluate ground and process water characteristics, to aid in the evaluation of potential environ-

mental impact, design of appropriate control technologies, and as a quality control check on data reported by DOE/LETC contractors. Dynamic process gas stream monitoring was conducted in support of LETC's retort and gasification facility, to provide the engineering staff with real time data to evaluate the current status of their tests, and to provide a responsive diagnostic tool to indicate process changes brought about by alterations in the operating conditions, such as heating rate, input gas composition, and pressure.

The environmental and process monitoring groups carried out monitoring efforts at the North Site's 150-Ton and 10-Ton retorts and at the Water Storage Warehouse. Instrumentation and instrumentation repair services were carried out at the Laramie Center, the North Site for oil shale research groups, and at Vernal, Utah, for the Tar Sand Group. These functions of the General Analysis Section were discontinued during October and final compilation of data and dispersal of equipment is underway.

During 1980, technical and management direction was supplied to a widely dispersed DOE program in the area of Fossil Energy Waste Characterization. The effort coordinated the work of four other Energy Technology Centers, the National Bureau of Standards, three National Laboratories, and over 15 contractors. The objective of the program is to develop a data base from a uniform protocol of sampling and characterization of fossil energy wastes for the purpose of defining their hazard potential after disposal.

Notable accomplishments by the General Analysis Section this year included the development of a coordinated Department of Energy/American Society for Testing and Materials multilaboratory testing program, which addressed the potential for leaching trace metals from various fossil energy related materials. The program isolated and measured the primary components of variability in the extraction procedures, established the degree of confidence in which the test results should be held, and indicated the experimental parameters which may be improved upon to yield better quality data. The test program served as the basis of a proposed ASTM Standard Method, currently up for final approval and acceptance.

A multilaboratory test program for the analysis and quantification of organics in leachates at the part-per-billion level was begun. The program will provide some initial data in this area, and will develop some confidence in the reliability of the method to provide quality data.

LETC personnel were instrumental in the founding of a new ASTM Committee on Waste Disposal, and they are currently heading major technical section activities, and serving as elected officers of the committee overseeing technical operations.

Spectroscopic Methods

The Spectroscopic Methods Section provides spectroscopic services and assistance to the Center's research programs, and develops new or applies existing spectroscopic techniques that aid in the characterization of fossil fuels. The major spectroscopic techniques employed by the section are mass spectrometry and NMR. During 1980, high and low mass spectral analyses, gas chromatographic-mass spectral analyses, and proton and carbon-13 nuclear magnetic resonance analyses were provided to numerous Center projects.

Within the section, progress was made on various individual research projects, such as pattern recognition and multinuclear NMR techniques. Besides advancing pure NMR and mass spectral techniques, the section is actively working on methods which utilize combinations of these two techniques, providing a level of information not available to the researcher when the two techniques are used separately.

Personnel from the section were also involved with outside agencies during 1980. A cooperative program, between the Spectroscopy Section and the Wright-Patterson Air Force Base, was established to investigate the potential of nuclear magnetic resonance for the characterization of jet fuels. Correlations between NMR data and combustion properties of jet fuels are being developed. If successful, the work will result in more cost-effective, less time-consuming performance tests for aviation fuels. Section personnel also provided technical assistance on a National Bureau of Standards program for the use of high frequency electromagnetic radiation on in situ retorts. In addition, a cooperative research program with the Colorado School of Mines was established to investigate epimerization of steranes in shale oils. The information obtained, hopefully, can be used as an index to a shale oil's thermal history. This information will be very helpful in understanding the processes that occur in the retorting of oil shale by any process, but will be especially useful in evaluating true and modified in situ processes, where real time sample and data acquisition is difficult, if not impossible.

RESOURCE CHARACTERIZATION

G.F. (Pete) Dana, Division Manager
Charlotte Miller, Division Secretary

While a field hand works to fix a pump hose in the background, Dave Jones and Donna Sinks, LETC geologists and Jim Lekas of Geokinetics examine a section of core.

Mark Lyon and Donna Sinks prepare an oil shale sample for analysis in the Fischer assay procedure.

Functional Summary

- **determines oil yields of hydrocarbon-bearing samples**
- **evaluates mineral content and other resource properties**
- **interprets data for alternative processing plans**
- **provides technical expertise for project activities**

During 1980, the Division of Resource Characterization, more than ever before, provided data, expertise, support, and guidance for LETC in-house and field projects in oil shale, tar sand, coal, and hydrology. The division continues to accumulate new data concerning potential energy sources evaluated by the Center, is becoming attuned to the needs of industry, and is providing up-to-date data on various problems. Areas of emphasis are resource identification, in situ site location, mechanical properties of energy-bearing strata, examination of post-burn features – both physical and chemical – and hydrological conditions and compositions of pre-burn and post-burn experiments.

Matrix organization is highly utilized within the division, especially from a geological and resource evaluation standpoint. Each of the division's geologists are principal contributors to the project management efforts of oil shale, tar sand, underground coal conversion, and hydrology. Data base development of these resources is enhanced by the development of programs for information storage and retrieval for tar sands and coal, in addition to earlier oil shale information.

Resource Evaluation

An oil shale post-burn coring program,

to evaluate two modified in situ retorts at Geokinetics, Inc., south of Vernal, Utah, was completed. The cores have been photographed, and the pictures will be combined with lithologic descriptions for a complete core record. The cores will then be divided and sent to the Lawrence Berkeley Laboratories (University of California), Colorado State University Hydrology Department, and LETC's Research Support Division for analyses at the request of the U.S. Environmental Protection Agency (EPA). Analyses performed at these institutions will partially answer questions concerning changes undergone by the oil shale during retorting and compounds remaining in the spent shale.

The PR Spring tar sand deposit in central Utah was further evaluated with a 7-hole coring program. The holes were strategically located to supplement existing data and thereby increase the accuracy of the resource assessment of this deposit. When these analyses are completed, they will be compiled and added to the U.S. tar sand data bank of geologic, engineering, and analytical information being maintained in this division.

Resource Evaluation has two members on the Center's Hydrology Task Force, which is responsible for obtaining pre-burn and post-burn data on field experiment test sites, principally coal and oil shale. At the recommendation of this task force, work has been performed at the Hanna underground gasification site to establish a baseline environment and a post-burn state. The baseline study included four coreholes, 22 water wells, and geophysical logging of the holes. Data obtained during the drilling and subsequent analysis will be sufficient to establish a baseline environment. With the installation of pumps in the wells, periodic sampling and analysis, and follow-up monitoring, the post-burn state will be determined.

In addition, research personnel on the underground coal gasification project from Resource Evaluation recommended and supervised work at the Hanna II site. Cores and data were sent from both the Hanna and Hoe Creek sites to: Colorado State University, to examine the coal environment, stratigraphy, and mineralogy; Wyoming Analytical Laboratories, Inc., for coal ultimate and proximate analyses and coal petrolgraphy studies, and Anwal Analytical and Consulting Laboratory, for geochemistry studies. When these studies are complete, Resource Evaluation will have adequate data to handle permitting requirements, to answer questions pertaining to the ground water regime, and to properly characterize the resource both before and following experimental burns.

The Resource Evaluation Section supplied one member to the Tar Sand Project Management Team for participation on an as-needed basis in the planning, execution, and evaluation of the tar sand steam injection projects near Vernal, Utah. Similarly, this section was designated to assist the Oil Shale Research and Development Management Team, and contributes planning recommendations along these lines.

Core Sampling and Evaluation

In 1980, two papers were published, evaluating oil shale resources of the Green River Formation. Available data was assembled to define the stratigraphic framework of oil shale resources in the Green River Basin, Wyoming. One paper, LETC/RI-80/6, provided a general picture of oil shale distribution and richness in the Green River Basin. The other, RI-80/11, presented resource data on shallow oil shales of the southern Uintah Basin suitable for Geokinetics-style development. Data was compiled on oil shale resources of the easter part of the Uintah Basin, and an evaluation will be published in 1981.

Lithology, stratigraphy, mineralogy, and oil-yield data were developed from Occidental's baseline core for Logan Wash retorts 7 and 8. This information will be vital for post-burn evaluation of fracturing and retorting effects produced by the experiment. Stratigraphic differences between oil shales of the Mahogany zone at Anvil Points and at Paraho's surface retort site near Bonanza, Utah, were compared for determining potential mine zones at each site. The comparison indicated very slight differences between the two sites, so that engineering data developed for Anvil Points should be applicable to the Utah site.

Lithology and oil-yield data from coreholes in Wyoming, Utah, and Colorado were added to the oil shale data base. Oil-yield assays were performed in support of many engineering, environmental, and process evaluation programs, and to evaluate oil shales from several foreign countries. Computer capabilities were enhanced for processing and plotting resource data.

Rock Mechanics

Three papers characterizing the mechanical properties of oil shale were published under a contract with the College of Engineering at the University of Wyoming.

During the year, mineral surveys were performed on two long LETC cores from the Green River Basin, and on a baseline core from Occidental's Logan Wash site. X-ray mineral identifications were made in support of several projects. A report on element and mineral distribution and relationships on Naval Oil Shale Reserve No. 1 was prepared in collaboration with Lawrence berkeley Laboratory. Data was developed and compiled for a paper describing mineral distributions and lithologic associations in oil shales of the Green River Basin.

Composition and Properties

A paper concerned with thermal behavior of dawsonite was published from work conducted at the University of Wyoming. The ability of nahcolite to remove stack-gas sulphur was the subject of other research, with results to be published in 1981.

A presentation was made to the American Association of Petroleum Geologists, detailing the kind and amount of alumina found in the oil shale of the Piceance Creek Basin and possible methods of extraction.

Abelsonite, a nickle-bearing porphyrin, was identified in oil shale cores, and a publication on its discovery and occurrence is forthcoming.

Element analyses in oil shale and other bitumen-bearing rocks were conducted in an atomic absorption spectrometer for resource characterization and processing evaluation. Approximately 120 samples were analyzed for four divisions within the Center.

ACADEMIC AFFAIRS

1980 University Research Contracts

University	Project
University of Washington	Flow and Reaction Coupling in In Situ Coal Gasification
University of Texas at Austin	Chemical, Mechanical and Environmental Factors in Underground Gasification of Texas Lignites
University of New Mexico	Evaluate, Characterize, and Assess the Potential of Underground Coal Gasification in the San Juan Basin of New Mexico
University of Denver	Testing of Water Treatment Technologies at the LETC 150-Ton Oil Shale Retort
New Mexico Tech	Laboratory Investigations for Exploiting Santa Rosa Tar Sands of New Mexico
University of California at Berkeley	Formation, Deposition, and Drainage of Mist in Porous Media with Application to Oil Shale Retorting
Ohio State University	Structural and Fracture Mechanics Modeling Associated with Underground Coal Conversion
University of Alabama	Feasibility Studies of In Situ Coal Gasification in the Warrior Coal Field
University of Missouri	Study of the Interactions of Process Water Solutes with Coal Materials at Various Stages of Coal Gasification
Texas A & M Research Foundation	Determination of Performance-related Properties of Selected Syncrude High-boiling Liquid and Residual Products and Up-graded By-products for Application as Recycling Agents
	Characterization of Mildly Hydrogenated Shale Oil Asphalts for Paving Purposes
Colorado School of Mines	The Role of Spent Shale in Oil Shale Processing and the Management of Environmental Residues
	Mineralogical and Geochemical Study of the Colorado Oil Shales
Colorado State University	Optimization of a ^{13}C Cross Polarization/Magic-Angle Spinning Spectrometer for Solid Fossil Fuel Samples
	Stratigraphy, Depositional Environments, and Mineralogy: Hanna Formation: Hanna UCC Site, Wyoming
	Observation and Quantification of ^{13}C NMR Signals from Solid Fossil Fuels at Various Temperatures by the Techniques of Solid State ^{13}C NMR-Cross Polarization and Magic Angle Spinning
University of Utah	Recovery of Oil from Utah's Tar Sands
	Factors Affecting In Situ Recovery of Hydrocarbons from Oil Shale
	The Relationship Between Optical Activity and the Degree of Degradation of Shale Oil
	An Investigation of Factors Affecting the In Situ Combustion Retorting of Oil Shale
	Investigation of Labile Compounds Resulting from the Pyrolysis of Oil Shale in High Vacuum

University	Project
University of Wyoming	Research on the Role of Spent Shale in Oil Shale Processing and the Management of Environmental Residues
	Characterizing the Mechanical Properties of Oil Shale
	Water Quality Characteristics of Fossil Fuel Processing Effluents – Tar Sands
	Mathematical Modeling and Laboratory Experimentation in Support of LETC In Situ Coal Gasification Field Test
	Study of Utilization of Nahcolite in a Dry SO_2-NOx Absorber System
	Effect of Aqueous Effluents from In Situ Fossil Fuel Processing Technologies on Aquatic Systems
	Shale Oil Composition Studies: Saturate and Nitrogen-type Compounds as Related to Retorting Parameters
	Provide Library Services in Support of Research Conducted at the Laramie Energy Technology Center
	Nuclear Magnetic Resonance (NMR) Spectrometer Time and NMR Spectroscopic Services Applicable to Fossil Fuel Analysis
	Determination of Relationships Between Chemical Compositional Parameters and Physical Properties that Control the Compatibility and Durability for Effective Utilization and Conservation of Fossil Fuel Heavy Products and Byproducts
	Development of Negative Ion Mass Spectrometer for Analysis of Olefins in Shale Oil
	Thermal Decomposition of Kerogen Under Elevated Pressure
	Phyto-toxicity and Plant Response to Aqueous Effluents Derived from In Situ Fossil Fuel Processing
	Thermal Behavior of Dawsonite as Related to Extraction of Alumina from Oil Shale
	Interactions of Soil Microorganisms with Aqueous Effluents Derived from In Situ Fossil Fuel Processing
	Investigations on the Use of Optical Activity of Shale Oil in the Retorting of Oil Shale
	Demonstrate the Feasibility of Using Spent Shale to Remove Hydrogen Sulfide from Oil Shale Retort Off-gas
	Determination of Corrosion and Erosion Rates Related to In Situ Steam Recovery of Oil from Tar Sands
	Rock Springs Site 12 Water Monitoring Project
	Spent Oil Shale/H_2S Scrubbing Reaction Kinetics Determination and Continuous Reactor Design
	Tar Sand Extraction by Steam Stimulation and Steam Drive-Measurement of Physical Parameters
	Tar Sand Extraction by Steam Stimulation and Steam Drive-Laboratory and Numerical Modeling
	Utilization of Nahcolite in a Dry SO_2, NOx Absorber System
	Characterizing the Mechanical Properties of Oil Shale
	Thermal Behavior of Dawsonite as Related to Extraction of Alumina from Oil Shale
	Theoretical and Experimental Investigations of Underground Coal Gasification
	Land Restoration for In Situ Oil Shale, Coal, and Tar Sand Processing Technologies
	Microbial Interactions with Aqueous Effluents Derived from In Situ Fossil Fuel Processing
	Water Quality Characteristics for Fossil Fuel Processing Effluents
	Investigation of Feasibility of Computerizing Chemical and Geological Data from Oil Shale, Tar Sand and Coal
	Development Separation Methods for Residues of Fossil Fuels

Associated Western Universities, Inc. (AWU) Expands at LETC – 1980

The AWU program, in which LETC has participated since 1976, showed a significant growth in 1980. This expansion was due in part to a new mechanism permitting part-time appointments during the normal academic year. The former procedures principally allowed only summer appointments.

This program was developed to help assure an adequate supply of human resources to assist with the nation's energy needs, to strengthen and augment the academic institutions' capabilities in understanding those needs in relationship to education in physical sciences and engineering, and to invigorate the laboratories and technology centers through the knowledge and ideas of faculty and student participants at those facilities. Participants this year (by division) included:

Division of Environmental Sciences –
- Vernon S. Archer, Associate Professor of Chemistry, University of Wyoming
- Darryl J. Bornhopp, Chemistry Graduate Student, University of Missouri-Columbia
- Bruce W. Culver, Assistant Professor of Pharmacology, University of Wyoming
- David H. Foster, Assistant Professor of Civil Engineering, University of Wyoming
- Elizabeth A. Gillis, Graduate Civil Engineering Student, University of Wyoming
- Garold L. Gresham, Chemistry Student, University of Wyoming
- Steve Hoeffner, Graduate Chemistry Student, University of Missouri-Columbia
- Michael J. Humenick, Associate Professor of Civil Engineering, University of Texas-Austin
- Corrine M. Kerr, Architectual Engineering Student, University of Wyoming
- Donald O. Lierman, Graduate Environmental Engineering Student, University of Wyoming
- Stanley E. Manahan, Professor of Chemistry, University of Missouri-Columbia
- Richard D. Noble, Assistant Professor of Chemical Engineering, University of Wyoming
- Forest R. Walter, Graduate Pharmacy Student, University of Wyoming

Division of Resource Characterization –
- Mark L. Lyon, Graduate Geography Student, University of Wyoming
- Lowell K. Spackman, Graduate Geography Student, University of Wyoming

Division of Research Support –
- David M. Barnhart, Professor of Physical Sciences, Eastern Montana College
- Patrick Hunter, Graduate Physics Student, University of Wyoming
- Cielette Karn, Graduate Zoology Student, University of Wyoming
- John M. Knox, Graduate Physics Student, University of Wyoming

Division of Physical Sciences –
- Roland E. Barden, Associate Professor and Head Chemistry Department, University of Wyoming
- Jeffrey A. Clark, Chemistry Student, University of Wyoming
- Cheri A. Folkner, Chemical Engineering Student, University of Wyoming
- Charles G. Ford, Post-Doctoral Chemistry Appointment, University of Wyoming
- Chris W. McGowan, Assistant Professor of Chemistry, Tennessee Tech. University
- Carol A. Revelt, Geology Student, University of Wyoming

Division of Engineering –
- Stanley G. Doak, Mechanical Engineering Student, University of Wyoming
- Charles E. Mitchell, Associate Professor of Mechanical Engineering, Colorado State University
- James Thomas, Professor of Mathematics, Colorado State University

Office of Environment and Conservation –
- Ira J. Winn, Professor of Education and Urban Studies, California State University

Associated Western Univer 'ty (AWU) student fellowship appointments at the Laramie Energy Technology Center for summer 1980 are shown above. AWU's program is an effort to ensure an adequate supply of manpower in the future of this country's energy and development programs. Shown above are: (kneeling, left to right) – Dr. Charles D. Ford, Patrick Hunter, :nd Steven Hoeffner; (standing left to right) – Darryl G. Bornhopp, Corrine M. Kerr, Harold Gresham, Elizabeth A. Gillis, Forest R. Walter, and Donald Lierman.

Faculty participants from the AWU program at LETC are: (standing, left to right) – Professors Ira Winn, California State University; David H. Foster, Vernon S. Archer, and Roland Barden, University of Wyoming; and Stanley E. Manahan, University of Missouri-Columbia; (kneeling, left to right) – Professors Chris W. McGowan, Tennessee Tech. University; Richard D. Noble, University of Wyoming; Charles E. Mitchell, Colorado State University; and David M. Barnhart, Eastern Montana College.

LETC personnel held the following official appointments at academic institutions during 1980:

Dr. Andrew W. Decora – Adjunct Professor of Chemistry and Engineering, University of Wyoming

Dr. Samuel M. Dorrence – Adjunct Professor of Fuels Engineering, University of Utah

Dr. Daniel A. Netzel – Lecturer in Chemistry, University of Wyoming

Dr. Richard V. Barbour – Member of Graduate Thesis Committee for Lynn Duvall, Master's candidate, Mechanical Engineering, University of Wyoming

Signers of the cooperative agreement between the University of Wyoming and LETC are shown above. From left to right: Samuel D. Hakes, UW College of Engineering Dean; Andrew W. Decora, LETC Director; Edward H. Jennings, UW President; and Joan K. Wadlow, UW College of Arts and Sciences Dean.

COMMITTEES

LETC's Equal Employment Opportunity Committee is comprised of (left to right): Clark LeDoux, Frank Davis, Jack Raymond, Chairperson Elden Almendares, Diana Bartke, Peggy Parker, and Shuang-Ling Chong.

The Combined Federal Campaign is a one-time solicitation among Federal personnel for voluntary health and welfare agencies. The 1980 Campaign was successful at LETC thanks to the group of volunteers pictured. From left to right (seated) Nadine Hurd, Janice Taylor, Rose Robinson; (standing) Frank Davis, Monte Fisher, George Campbell, Tom Owen and George Miyake. Also helping with the Campaign was Carl Roonmagi.

Equal Employment Opportunity Committee

During 1980, LETC instituted five Upward Mobility positions, the first ever at the Center. The positions are Accounting Technician (2), Secretary, Purchasing Agent, and Equipment Specialist.

Management representatives on the Committee in 1980 were Dick Martel and Dick Poulson. In response to the new program, Frank Davis was appointed as Class Action Counselor, in addition to his regular EEO Counselor responsibilities. Clark LeDoux, the Selective Placement Program Coordinator, resigned from the Center. His many contributions to the Committee will be missed.

Members spent considerable time developing the Center's 1980 Federal Equal Opportunity Recruitment Program and has initiated contacts with the University of Wyoming and the state of Wyoming to try to bring "Upward Bound" and CETA employees on board.

During the year, a survey on sexual harassment was conducted by the Federal Women's Program Manager as part of a DOE-wide survey. Planning has begun to institute a LETC Federal Women's Program Advisory Committee.

Other topics discussed by the Committee during the year included: grievance procedures, the effects of LETC's decreased ceiling on Affirmative Action, procedures for getting on an OPM register, and utilization of Associated Western Universities students to further LETC's Affirmative Action goals.

Energy Management Committee

During FY 1980, the LETC Energy Management Committee –

- surveyed LETC personnel for energy conservation needs and suggestions
- gathered preliminary design data for the storm window project
- reviewed and maintained the LETC Energy Awareness Board to keep visible a periodic record of the volumes and costs of nonrenewable energy used by the Center
- initiated the "LETC Noon Event," a twice-weekly film series, designed to encourage LETC personnel to bring their lunches to work instead of leaving during the lunch hour.

LETC Personnel Club

The LETC Personnel Club sponsors the annual LETC Christmas party and picnic, and provides flowers or other appropriate gifts to members and their families in the case of birth, illness, weddings, retirements, and death.

The Club's annual meeting for election of officers was held in Spetember 1980. Officers elected were: Pete Dana, President; Dave Hones, Vice-President; Rose Robinson, Secretary; and Dick Martel, Treasurer.

LETC's Communication Committee Henry Plancher, Pete Dana and Fran Miknis and staffers Carla Sanchez and Suzanne Urbom from Office Services meet before duplicating the Newssheet on the new copier.

The Library Committee is comprised of (left to right): Leroy Dockter, Daniel Netzel, Donna Sinks, Chairperson John McKay, and Librarian B.J. Davidson.

The Laramie Energy Technology Center Occupational Safety and Health Council reviews the specification for the New Chemical Storage facility. Left to right seated are: Neil Young, Resources Characterization Division; Terry Brown, Chairman; William H. Weaver, Safety Engineer; and John Bigelow, Engineering Division. Standing: Chris Laya, Operations Division; Carl Roosmagt, Environmental Science Division; F.R. McDonald, Research Support Division; Raymond Robertson, Physical Science Division; and Leo Romanowski, Tar Sand Projects.

Communications Committee

The communication committee recognizes that effective communication at all levels is the only viable approach toward the development of a mutual understanding among all Center employees. This committee is responsible for overviewing most aspects of communication within the Center. The committee's main activity is the preparation of the LETC Weekly Newssheet.

Library Committee

The LETC Library continues to operate through a contract with the University of Wyoming Science Library. The staff provided by the Science Library consists of one professional librarian, one part-time library technician, and one part-time secretary/bookkeeper. The contract agreement includes full access to the University of Wyoming's library services and materials. This committee advises in the operation of the LETC library.

The active collection at LETC consists of approximately 2,500 monographs, 125 periodical titles, numerous government documents, and a file of publications by LETC authors. Services provided by the library include: reference, photoduplication, interlibrary loans, collection development, and data-based bibliographic searching. During 1980, the library filled 2,100 requests for materials.

Safety Council

The LETC Safety Council received charter approval in August 1980. The Committee was established to act as an advisory body to the Director on matters of safety and health policy, programming, and practices. Quarterly meetings were held to discuss and view complaints, safety projects, accidents, and inspections. Major activities included: reviewing the LETC Occupational Safety and Health (OSH) Training Program, developing the LETC OSH Program Plan, and identifying other needs. In the future, the committee expects to conduct inspection of LETC workplaces, develop an incentive awards program, and assist in the development of a health service program.

Laboratory Safety Committee

The Laboratory Safety Committee was established in compliance with the LETC Occupational Safety and Health Program. The purposes of this committee are: (1) to assist in evaluating and developing safety procedures and practices for the LETC laboratories, (2) to provide expertise on specific safety and health problems; (3) to assist in safety surveillance of the labs, and (4) to provide safety and health training for laboratory personnel.

The committee has been active in several areas, including developing formats for the LETC Laboratory Safety Document, inventorying the chemical stockroom, removing dated chemicals from the oil storage building, conducting safety reviews, and initiating the development of adequate chemical storage facilities. A most important contribution is the LETC Laboratory Safety Document, which will provide a general laboratory layout, locate hazardous materials, illustrate external power breakers, and detail the power circuitry and load for that laboratory. When complete, the document will be of great assistance to the Safety Manager, the Laramie Fire Department, and other safety groups in the event of an emergency.

LETC's Lab Safety Committee pauses during one of their lab inspections. The committee members are: (foreground) Larry Trudell, (background left to right) Dick Barbour, Tom Cogswell, Leroy Dockter, Tom Spedding, Frank Guffey, and Sonja Ringen. Chairperson, Larry Jackson is not shown.

MEETINGS

LETC had a key role in eight important meetings held during the year. They were:

- The 3rd Annual Oil Shale Conversion Symposium sponsored by LETC was held January 15-17, 1980, in Denver, Colorado, with more than 160 participants from industry, universities, and Federal and state agencies. The principal purposes of the conference were to disseminate information among present and prospective contractors of DOE in the area of oil shale technology and to inform industry, government, academia, and the public of advances being made and plans for continued work in this area by DOE. Forty-two technical papers, related to oil shale work supported by the Division of Fossil Energy Extraction of the U.S. Department of Energy, were presented.

- The 13th Oil Shale Symposium was held April 16-18, 1980. It was cosponsored by the Colorado School of Mines and the Laramie Energy Technology Center. A total of 36 papers were presented and published in the proceedings. Twenty-two of the papers were on oil shale and shale oil processing and characterization, and 14 papers were on environmental aspects of oil shale development. There were 350 attendees from industry, academia, and government.

- A Tar Sand Permeability Enhancement Workshop was hosted by the LETC Tar Sand Projects on May 8-9, 1980, in Albuquerque, New Mexico. Ten professional papers were presented. There were 22 attendees from DOE, National Laboratories, the Canadian Government, U.S. and Canadian universities, and U.S. and Canadian industry.

- The 7th Annual Asphalt Research Meeting, largest continuing national forum devoted to ongoing research on factors affecting asphalt properties and performance, was sponsored in Laramie by the Product Utilization Section of the Division of Physical Sciences, with more than 65 participants in attendance. The meetings was held July 16-17. Over 20 technical papers were presented.

- Confab 80 was hosted by the Division of Physical Sciences on July 22-25 at the University of Wyoming. This was the 29th annual meeting sponsored by LETC to provide a forum for discussions of fossil fuel chemistry and engineering. More than 80 attendees, including several foreign visitors, participated. Sessions included more than 25 technical papers on characterization, processing, upgrading, and environmental studies related to fossil fuels.

- The 6th Annual Underground Coal Conversion Symposium, sponsored by DOE/LETC, was held in Afton, Oklahoma, in July. Sixty-seven papers, covering a broad range of topics important in UCG technology, were presented. A number of papers by LETC personnel, or sponsored by DOE/LETC, were presented.

- Public meetings for the Surface Oil Shale Demonstration Project Environmental Impact Statement (EIS) were held in Vernal, Utah, and Denver, Colorado, in August. Critical environmental issues associated with the construction of demonstration surface oil shale modules were identified.

- An Oil Shale Colloquium, cosponsored by the Kingdom of Morocco, the Agency for International Development (U.S. State Department), and DOE, was held in Rabat, Morocco, October 6-10, 1980. Dr. Decora was the General Chairman of this Colloquium along with Mohamed Sdiqui, Director of Energy, Ministry of Energy and Mines, Morocco. Most of the world's leaders in oil shale technology were in attendance at this Colloquium, which had as its primary objective the presentation of United States oil shale technology to the Moroccan Government.

- The LETC Tar Sand Project held an Executive Committee meeting in Vernal, Utah, November 13, 1980. Progress reports were presented on six cooperative projects along with administrative discussion. Attendees included nine members of the Executive Committee, representatives of DOE, the Canadian Federal Government, Alberta and Saskatchewan Provincial Government, and eight technical project representatives.

FOREIGN VISITORS

Some of the foreign visitors of LETC hosted in 1980 are shown in the accompanying photographs. As Dr. Decora indicated in the Director's Message, we were visited by 35 individuals representing 11 foreign countries.

Brazilian Officials: (Left to right) Giancarlo Alberto Andreoni, CONFAB Industrial, S.A.; Dr. Roberto Y. Hukai, Governo do Estado de Sao Paulo, Brazil; and Dr. Andrew W. Decora, LETC Director.

Visitors from Thailand: (Left to right) Kiattisak Nutalaya, Chief Chemist, Electrical Generating Authority of Thailand; William E. Little, LETC Oil Shale Projects Manager; Payungyuth Ativitavas, Chief of Research, Electrical Generating Authority of Thailand; and Kitti Sumrit, Provincial Electricity Authority of Thailand.

Spanish Energy Officials from Empresa National Adaro de Investigacionas, Mineras, S.A. Madrid, Spain: (Left to right) Bruce C. Sudduth, Manager, LETC Division of Engineering; Jose Luis Berzal-Fernandez; William E. Little, LETC Oil Shale Projects Manager; Luis C. Fernandez-Espinar; and Carlos Gomez-de-Salazar.

High-ranking Moroccan Energy Officials: (Left to right) Richard A. Martel, LETC Engineer; Rabah Bouchta, Secretary General, Bureau de Rescherches de Participationes Minieres; Mohamed Sdiqui, Department of Energy, Government of Morocco; and Dr. Andrew W. Decora, LETC Director.

The Yugoslavian Oil Shale Exploration Team: (Left to right) Milan Stojanovic, Director of Development Center – Mining and Industrial Crombinat; Predrag Janjic, Mechanical Engineer; Dr. Richard J. Jiacoletti, LETC Assistant Director for Project Management; Dr. Branko Kapor, Deputy Director of the Rudarski Institute; Ivan Mijatovic, Advisor to the General Director of the Oil and Gas Refinery; and Dr. Andrew W. Decora, LETC Director.

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1980 SUMMARY OF RESEARCH ACTIVITIES

		Funding Level Thousands of Dollars Fiscal Year 1980	
COAL			
ADVANCED ENVIRONMENT CONTROL TECHNOLOGY		2,080	
ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT		130	
UNDERGROUND COAL CONVERSION		3,062	
COAL SUBTOTAL			5,272
GAS			
ENHANCED GAS RECOVERY		352	
GAS SUBTOTAL			352
PETROLEUM			
ADVANCED PROCESS TECHNOLOGY		722	
TAR SAND			
Heavy Oil Recovery		366	
Preparation and Recovery		3,909	
Reservoir Access		288	
Resource Assessment & Planning		200	
TAR SAND SUBTOTAL		4,763	
OIL SHALE			
Environmental Compliance		235	
Environmental – Wastewater & Effluents		276	
Resource Assessment		443	
Kinetics, Reactions & Transport Phenomena		2,570	
Product Preparation		387	
Project Management		564	
Industrial Cooperative Projects		15,682	
Occidental	8,890		
Geokinetics	2,500		
Equity	1,692		
Dow Chemical	1,600		
OIL SHALE SUBTOTAL		19,157	
PETROLEUM SUBTOTAL			24,642
LETC TOTAL			30,266

RETIREMENTS & AWARDS

RETIREES

Bill Robb	November 7
Harold McCabe	December 19

Web Robinson February 22

Bill Haines April 5

Ward Smith July 30

Tom Sterner September 5

MERIT AWARDS

Steve Whittenberger

Jan Parker

Brenda Manuelito

Rich Marron

END OF PAPER