NIPER-686
May 1993

NIPER
Commitment to Excellence

MONTHLY PROGRESS REPORT FOR APRIL 1993

Work Performed for the
U. S. Department of Energy
Under Cooperative Agreement DE-FC22-83FE60149

National Institute for Petroleum and Energy Research
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DISCLAIMER

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FOREWORD

The Monthly Progress Report for April 1993, NIPER-686, is submitted in accordance with the provisions of Cooperative Agreement DE-FC22-83FE60149 between the Department of Energy and the IIT Research Institute.

The status of a new project, designated as SGP72 and funded under the Supplemental Government Program, is included in this report. The objectives of the project are to achieve effective coordination of technology transfer efforts among DOE and the diverse organizations that are part of the petroleum industry and to provide feedback to DOE regarding technology needs of the petroleum industry.

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SUMMARY

ENERGY PRODUCTION RESEARCH

Organization and coordination of the technology transfer conference, New Technology for Independent Producers, to be held in Denver, CO, May 6-7, 1993, has continued. NIPER personnel will chair the Reservoir Characterization and Biotechnology sessions and present eight papers at the meeting, four of which reflect work conducted in project BE1. Talks to be presented by the project staff personnel include subjects such as the effects of rservoir heterogeneity on oil recovery efficiency, reservoir characterization for EOR potential evaluation, application of standard petrographical analysis, and application of hydrogeochemical techniques to reservoir characterization. (BE1)

The compiled BOAST simulator has been tried on several one- and two-dimensional (1-D and 2-D) simulations. On 2-D data sets involving approximately 3,000 grid blocks, the simulator takes about 30 minutes to perform 600 trials before reaching terminating conditions. For a 1-D data set involving 40 grid blocks, the simulator takes 33 seconds to perform 1,000 trials before reaching endpoint. During this 33 second run, the simulator output 36 data files showing the 1-D oil, water, and gas saturations and how the flood front traversed the length of the model during the simulation. Now that the simulator is working properly, it will be used to study 1-D and 2-D models based on permeability, porosity, capillary pressure, and saturation distributions representative of real rock systems under study in the laboratory. (BE9)

A topical report, entitled "Evaluation of NIPER Thermal EOR Research, State of the Art and Research Needs," (NIPER 675) has been delivered to the BPO. This report summarizes NIPER's thermal recovery research over the past 10 years, analyzes contributions of the research, describes the transfer of the technology to potential users, defines current trends in thermal research and thermal oil production, and identifies areas where NIPER can contribute to future advances in thermal oil production. (BE11A)

Numerical simulation of a steamflood in the Taylor-Ina (TX) field is in progress. The feasibility of improving steamflood performance with CO_2 as an additive is being investigated. A literature survey of a steamflood using CO_2 was undertaken to collect the requisite data for simulation. The Computer Modeling Group's phase behavior model (CMG PROP) will be used in modeling CO_2-steam phase behavior. (BE11B)

A paper, entitled "Imaging Technology Applied to Rock and Fluid Imaging in Cores," will be presented at the New Technology for Independent Producers Workshop to be held in Denver, CO, May 6-7. (BE12)

Report NIPER-606, "Estimates of Future Regional Heavy Oil Production at Three Production Rates—Background information for Assessing Effects on the U.S. Refining Industry," has been delivered to the BPO. In addition, an update of trends in heavy oil production and refining in California was presented and published in the Proceedings of the American Chemical Society Symposium on Enhanced Oil Recovery, that was held in Denver, CO, Mar. 28-Apr. 2. (SGP37)

Nineteen students have accepted offers to participate in the summer intern program. Each student has been notified as to safety training, seminars, and meetings planned for the summer. Topics of the seminars include geology, primary and secondary recovery, EOR, biotechnology, and environmental issues associated with petroleum production. The teacher-interns from NIPER and Phillips Petroleum Co. also plan to attend the seminars. (SGP50)

Information pertaining to the curriculum of the Oil and Gas Exploration module was presented to Mike Benard, president of the Midcontinent Oil and Gas Association, and Mickey Thompson, executive vice-president of the Oklahoma Independent Peteroleum Association. Both gentlemen displayed considerable interest in the curriculum and suggested that NIPER present additional information on the module at future meetings of their respective organizations. (SGP61)

The papers, extended abstracts of poster session presentations, and summary of a panel discussion have all been assembled into the Proceedings of the symposium on the field application of foams (NIPER-699). The Proceedings will be available for distribution following publication as a DOE/FE report. (SGP63)

An organizational meeting was held in Austin, TX, Jan. 18, to discuss formation of an industry committee to facilitate transfer of oil and gas technology to the domestic petroleum industry. This meeting was conducted as part of a new SGP project established to implement an oil and gas technology transfer initiative. Participants of the

meeting included representatives from the petroleum industry, societies, and trade associations and observers from DOE and the national laboratories. Representatives from TIPRO, TORP, Illinois Geological Survey, and New Mexico Petroleum Recovery Research Center made brief presentations relating to ongoing technology programs. A majority of those attending selected the name of the coordinating committee to be the Petroleum Technology Transfer Council. (SGP72)

FUELS RESEARCH

Cat cracking of Lagomedio >650° F resid, and chromatographic fractions thereof, has been completed. Solid and liquid products from those runs are currently being analyzed. Analysis of Brass River products also has been completed; those data are being entered into the computer for calculation of material balances. (BFR2)

A journal article, entitled "The Thermodynamic Properties of Thianthrene and Phenoxathiin," has been accepted for publication in the *Journal of Chemical Thermodynamics*. (BFR3)

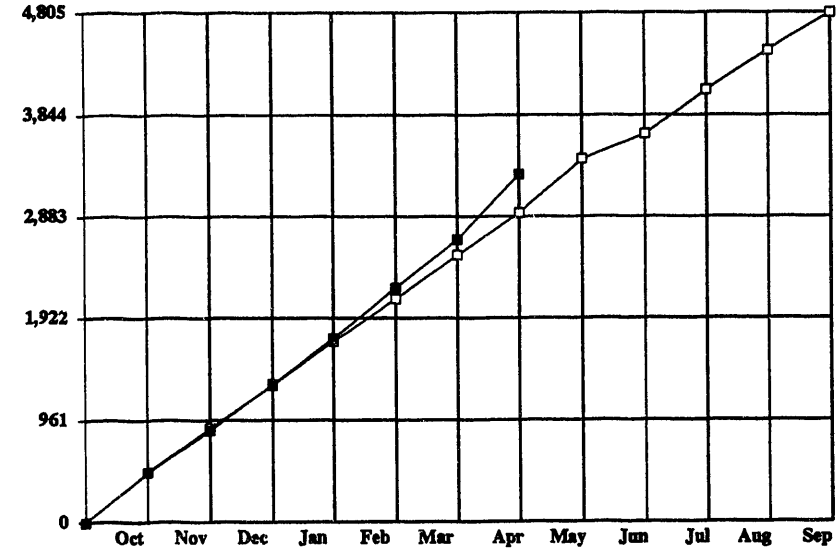
A commercial zone-refining apparatus has been received and assembled. Testing and determination of operating parameters has begun. A sample of 1,2,3,4-tetrahydrofluoranthene, synthesized by Oklahoma State University, will be zone refined once the apparatus is operational. (SGP49)

BASE PROGRAM

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		5,000,000
Less Capital Equipment:	197,600	
Appropriation Balance:	4,802,400	
Expenditures for the Month:		617,434
Total Expenditures to Date:		3,282,711
Net Available:		1,717,289
Capital Equipment Expenses and Commits:		23,543

Financial Status

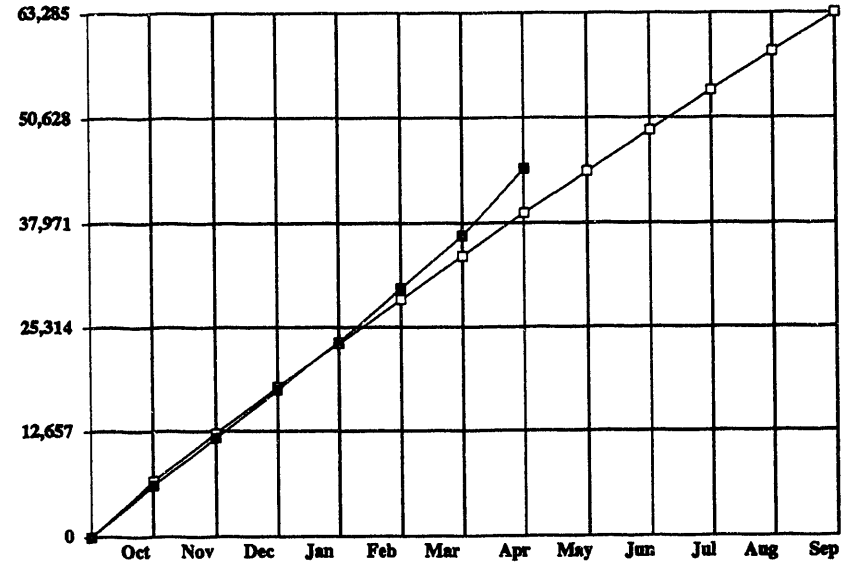


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	477	882	1289	1700	2098	2515	2917	3430	3667	4072	4445	4802
Actual	469	864	1297	1730	2202	2665	3283					
Variance	8	18	-8	-30	-104	-150	-366	3430	3667	4072	4445	4802

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		63,283
Man-hours used this Month:	8,117	
Total Man-hours used to Date:		44,552
Net Available:		18,731

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	6594	12413	17961	23318	28701	33983	39242	44199	49147	53953	58712	63283
Actual	6114	11806	17680	23464	30045	36415	44552					
Variance	480	607	281	-146	-1344	-2432	-5310	44199	49147	53953	58712	63283

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

BE1

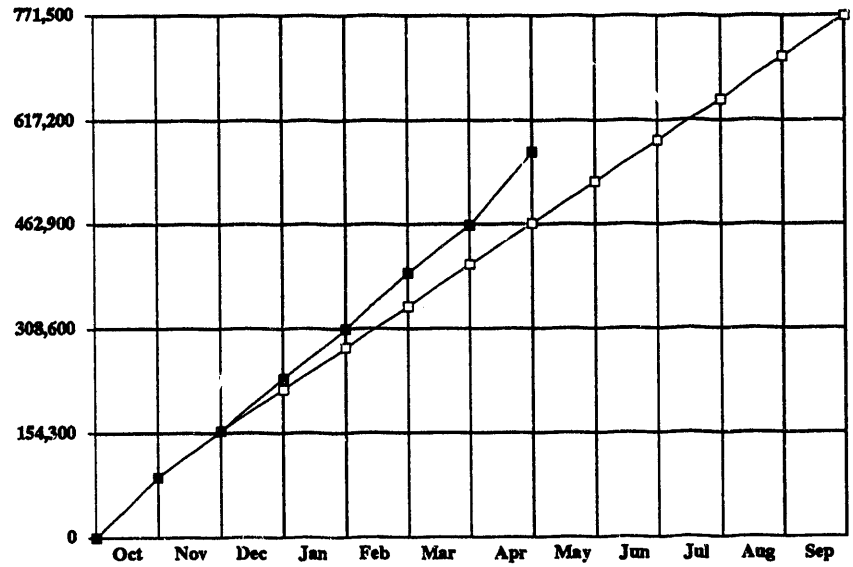
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		795,000
Less Capital Equipment:	23,500	
Appropriation Balance:	771,500	
Expenditures for the Month:		108,673
Total Expenditures to Date:		569,476
Net Available:		225,524
Capital Equipment Expenses and Commits:		4,488

Annual Plan Project BE1

Reservoir Assessment and Characterization

Financial Status

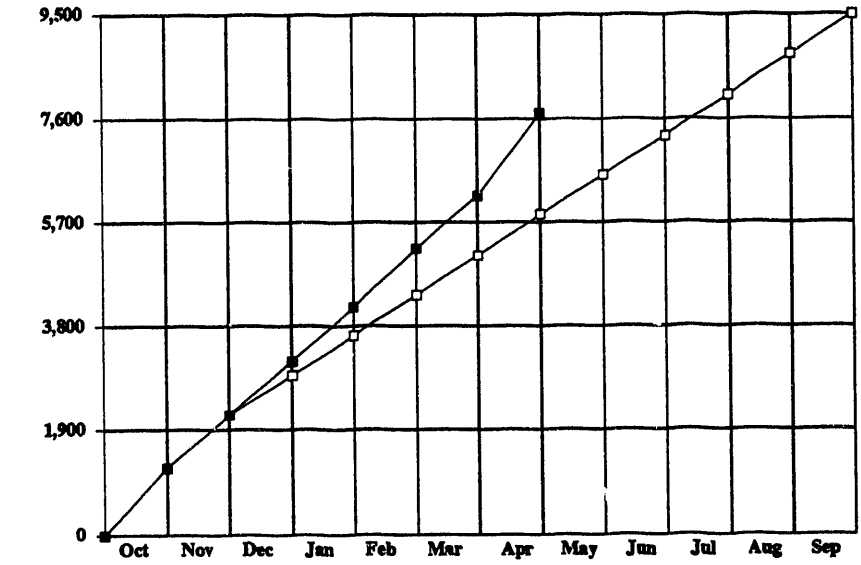


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	90	157	219	280	341	403	464	526	587	648	710	771
Actual	90	157	235	308	390	461	570					
Variance	0	0	-16	-28	-49	-58	-106	526	587	648	710	771

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		9,500
Man-hours used this Month:	1,531	
Total Man-hours used to Date:		7,713
Net Available:		1,787

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	1218	2165	2899	3632	4366	5099	5833	6566	7300	8033	8767	9500
Actual	1218	2165	3165	4141	5223	6182	7713					
Variance	0	0	-266	-509	-857	-1083	-1880	6566	7300	8033	8767	9500

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C' = Revised Completion Date
C'' = Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Project Environmental, Safety, and Health Assessment — XXX XXC

2 Complete Summary of Shoreline Barrier Deposits and Evaluation of Effective Oil Recovery Processes — _____XXX XXX XXX XXX XXX XXX _____C

3 Complete Updated Data Base on Patrick Draw Field and Annotated Bibliography on Shoreline Barrier Deposits — _____XXX XXX XXX XXX _____C

4 Prepare Chapter for NIPER Final Report Summarizing Accomplishments of Project BE1 (Draft Complete by April 15) — _____XXX XXX _____XXX _____C

5 Status Report Describing Plan for Characterizing Class 1, Fluvial-Dominated Deltaic Reservoirs — _____C

6 Promote Information Exchange & Complete Technology Transfer Activities — XXX XXX XXX XXX XXX XXX XXX _____C

ENERGY PRODUCTION RESEARCH

BE1. RESERVOIR ASSESSMENT AND CHARACTERIZATION

Accomplishments

The objectives of this project are (1) to develop geological and engineering methods to predict mobile oil saturation distribution and quantify reservoir architecture and flow unit geometry for application to targeted infill drilling and EOR and (2) to synthesize reservoir and production characteristics of shoreline barrier reservoirs and to determine similarities and differences and the degree to which information from one reservoir can be applied to another.

Milestone 2—Decline curve analysis of production data from Patrick Draw (WY) field is being evaluated for its potential use as a reservoir characterization tool. The decline curve analysis offers reliable reserve estimates and provides accurate calculation of reservoir parameters such as the drainage area or the skin factor which are of critical importance in any enhanced oil recovery operation. Parameters obtained from decline curve analysis may be compared with those obtained from seismic or wireline log interpretations for a greater degree of confidence before initiating an expensive EOR project.

Estimations of reservoir parameters from the decline curve data are based on a trial and error approach in which values of certain parameters have to be known before others can be calculated. Decline curve analysis and comparison of reservoir parameters were performed on Monell wells 1 and 14 from Patrick Draw field. Porosities and pay thicknesses previously determined from core-log correlations indicate that Monell 14 is located in a much more uniform part of the reservoir as compared to Monell 1 which is located in an area of significant depositional and structural heterogeneities. Decline curve analyses drainage radii of 333 ft for Monell 1 and 2,100 ft for Monell 14 support the previous findings. A large negative skin factor of -4.5 in Monell 14 suggests a significant effect of stimulation in this well as compared to that in Monell 1 which had a skin factor of 0. The OOIP in Monell 1 was estimated to be 1.088 MMBBLs compared to 4.966 MMBBLs in Monell 14. The type curve match for well Monell 14 suggested that the drainage is characteristic of a layered reservoir with no communication between layers. In contrast, the values calculated for well Monell 1 indicate that the effect of layering is small. While the actual values of these parameters will depend upon the accuracy of the input parameters like formation pressure or water saturation, analysis of decline curves can independently provide information about relative variations of certain reservoir parameters in a producing field.

Milestone 3—Report NIPER-622, "Annotated Bibliography of Selected References on Shoreline Barrier Island Deposits With Emphasis on Patrick Draw Field, Sweetwater County, Wyoming," is in preparation.

Milestone 4—The section of the final report summarizing the FY93 research activities and accomplishments has been completed. A draft of the entire report is nearly complete.

Milestone 6—Organization and coordination for the technology transfer conference, New Technology for Independent Producers, Denver, CO, May 6-7, 1993, has continued. NIPER personnel will chair the Reservoir Characterization and Biotechnology sessions and present eight papers at the meeting, four of which reflect work conducted in project BE1. Text and figures for the preprints, as well as slides and talks have been prepared. Talks to be presented by project staff personnel include subjects such as the effects of reservoir heterogeneity on oil recovery efficiency, reservoir characterization for EOR potential evaluation, application of standard petrographical analysis, and application of hydrogeochemical techniques to reservoir characterization.

The paper, entitled "Integration of a Geological-Engineering Model with Production Performance: A Case Study at Patrick Draw Field, Wyoming," was accepted by SPE for presentation in the Development Geology and Geophysics Poster Session of the 1993 SPE Annual Meeting at Houston, TX, Oct. 3-6.

A proposal has been submitted to the DOE Office of Fossil Energy for a cooperative project with Russia to optimize petroleum production in both countries. The application of modern technologies for advanced reservoir characterization and improved oil recovery to enhance production from known reservoirs was emphasized in the proposal, drawing heavily on technology developed in BE1 and related SGP projects supported by DOE.

Four proposals for the Small Business Innovative Research program were reviewed for the Department of Energy.

A tour of NIPER facilities was conducted for a group of Tulsa University professors and students. Presentations regarding the reservoir characterization research program and the petrographic image analysis and CT laboratories were provided by staff personnel.

Manpower and Financial Status

Financial expenditures and manpower are higher than predicted due to the early milestone completion dates and greater than anticipated efforts required in organizing a technology transfer conference.

Status of Project Milestones

Project milestones are on schedule.

BE2

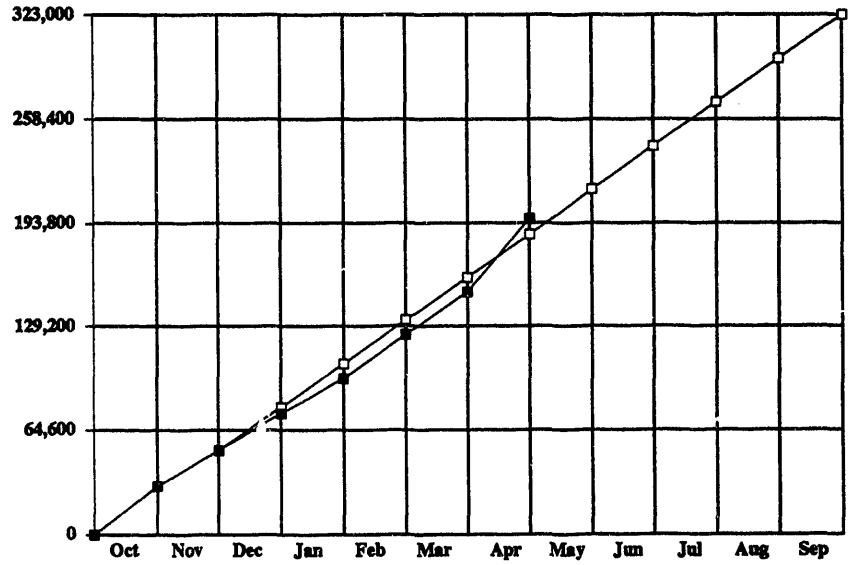
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		340,000
Less Capital Equipment:	17,000	
Appropriation Balance:	323,000	
Expenditures for the Month:		45,719
Total Expenditures to Date:		196,671
Net Available:		143,329
Capital Equipment Expenses and Commits:		0

Annual Plan Project BE2

TORIS Research Support

Financial Status

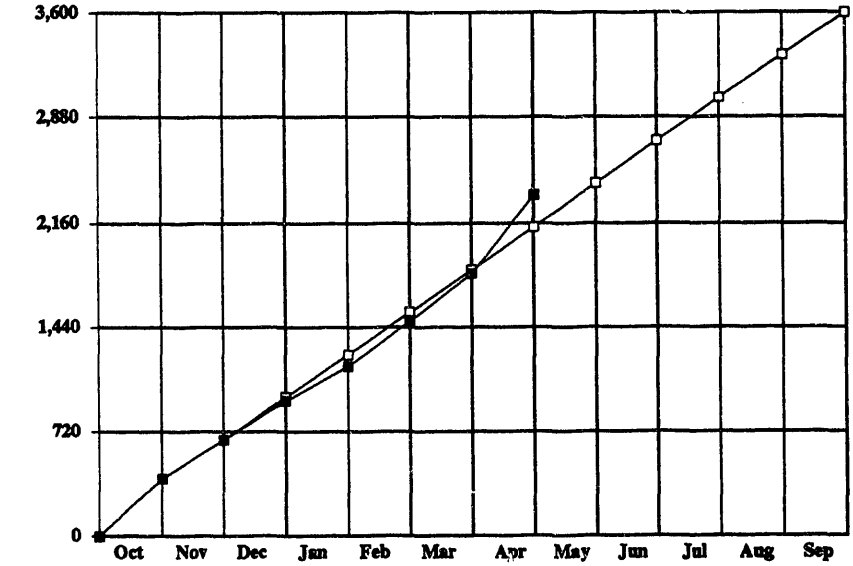


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	30	52	79	105	133	160	187	215	242	269	296	323
Actual	30	52	75	97	124	151	197					
Variance	0	0	4	9	9	9	-10	215	242	269	296	323

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		3,600
Man-hours used this Month:	535	
Total Man-hours used to Date:		2,347
Net Available:		1,253

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	394	662	956	1250	1543	1837	2131	2425	2719	3012	3306	3600
Actual	394	662	931	1170	1482	1812	2347					
Variance	0	0	25	80	61	25	-216	2425	2719	3012	3306	3600

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C' = Revised Completion Date
C'' = Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Project Environmental, Safety, and Health Assessment	XXX XXC
2 Status Report on Review of the INGRES Version of the EOR Project Data Base and Assessment of Future Needs	XXX XXX XXX XXX ____ XXX _____ C'
3 Prepare Chapter for NIPER Final Report Summarizing Accomplishments of Project BE2 (Draft complete by April 15)	XXX XXX XXX XXX ____ XXX XXX _____ C
4 Complete FY93 Research Support of EOR Project Data Base	_____ XXX XXX XXX XXX XXX _____ C
5 Complete FY93 Support of RSVR Reservoir Data Base	_____ C
6 Complete FY93 Computer Modeling Research Support	_____ C
7 Status Report Summarizing 1991 Data Collected for Incentive Projects	_____ XXX XXX XXX XXX _____ C
8 Topical Report Defining Estimated Confidence Level of the TORIS EOR Predictive Models	_____ XXX XXX XXX XXX XXX _____ C

BE2. TORIS RESEARCH SUPPORT

Accomplishments

The objective of this project is to provide research support to the DOE Program Manager for the Tertiary Oil Recovery Information System (TORIS) in the areas of enhanced oil recovery (EOR) project and reservoir data base management, EOR project technology and trends analysis, and computer simulation.

Milestone 3—The work on the BE2 chapter for the NIPER final report was a priority task during the month, and the initial draft is nearing completion.

Milestone 4—Research support of the EOR Project Data Base consisted of correcting and updating the two versions. While updating the INGRES version, some of the errors found in the S2k version were identified as already corrected. At least some the unexpected corrections relate to the method of forming the INGRES version from the S2k version—dates were disaggregated to eliminate date-related errors. A detailed analysis of what data were changed and why, as well as updating the INGRES version, will continue.

Milestone 7—Letters requesting 1992 and 1991 (when appropriate) data on the Tertiary Incentive Projects were mailed in February. Forty-nine responses have already been received for 1992, three for 1991, and two for 1990. Of the total fifty-four forms, 43 are active, leaving 11 either terminated, abandoned, shut-in, or sold. Production and injection data from most of the responses were entered into a working file.

Milestone 8—Work under this task has concentrated on comparing oil production from 15 steam projects in the Tertiary Incentive Program to estimated oil production of the TORIS model. Since there are more steam projects than any other EOR process, this will provide the best opportunity to statistically estimate the accuracy of the model. Aggregated results show excellent agreement between the TORIS model and the selected projects. Unfortunately, the variation of actual and simulated oil production between the model and the actual project is significant. After rigorous review of all the project data, a series of reruns of the projects has been made to ensure that the starting oil in place is appropriately represented. Although results for specific projects changed during this review, the statistical results changed very little. Since the total oil production is in good agreement, it was decided that sampling should be expanded to as many steam projects as possible.

Manpower and Financial Status

Manpower and financial expenditures are on schedule.

Status of Project Milestones

Project milestones are on schedule.

BE3

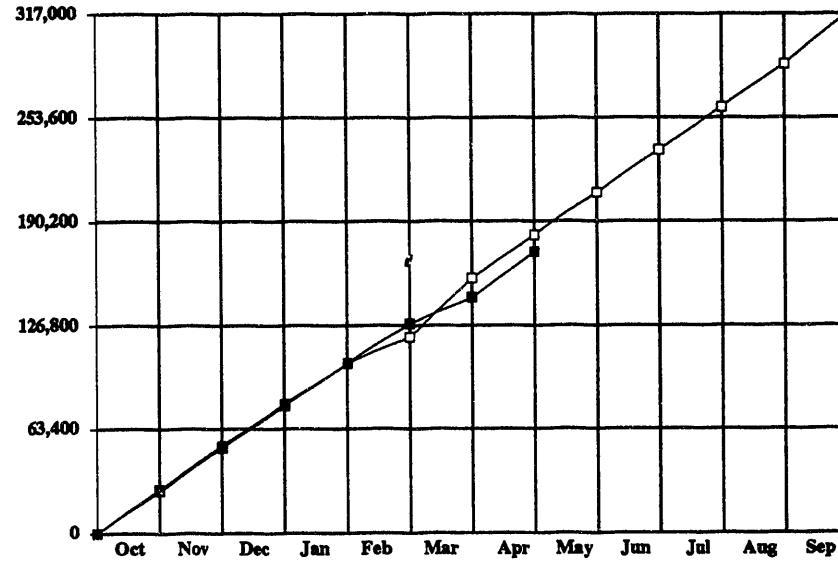
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		320,000
Less Capital Equipment:	3,000	
Appropriation Balance:	317,000	
Expenditures for the Month:		27,709
Total Expenditures to Date:		171,548
Net Available:		148,452
Capital Equipment Expenses and Commits:		3,729

Annual Plan Project BE3

Development of Improved Microbial Flooding Methods

Financial Status

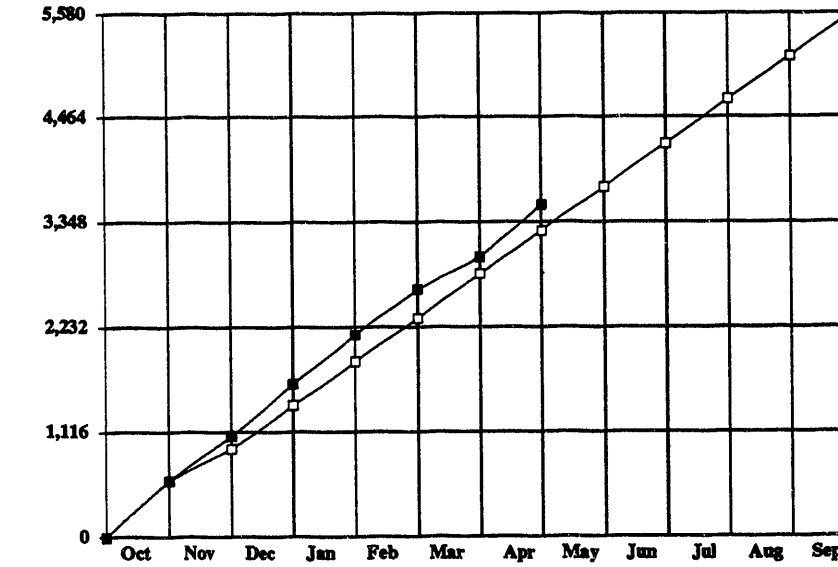


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	26	52	78	104	120	156	182	208	234	260	286	317
Actual	27	53	79	104	128	144	172					
Variance	-1	-1	-1	0	-8	12	10	208	234	260	286	317

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		5,580
Man-hours used this Month:	567	
Total Man-hours used to Date:		3,532
Net Available:		2,048

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	592	930	1395	1860	2325	2790	3255	3720	4185	4650	5115	5580
Actual	592	1065	1625	2149	2625	2965	3532					
Variance	0	-135	-230	-289	-300	-175	-277	3720	4185	4650	5115	5580

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Project Environmental, Safety, and Health Assessment — XXC
2 Complete Evaluation of Microbial Systems in Porous Media Using CT/NMR-Imaging Techniques — ____ XXX XXX XXX XXX XXX XXX _____C
3 Complete Experiments Investigating the Role of Microbial Polymer Production in Oil Recovery — ____ XXX XXX XXX XXX XXX XXX _____C
4 Prepare Chapter for NIPER Final Report Summarizing Accomplishments of Project BE3 (Draft complete by April 15) — ____ XXX XXX XXX XXX XXX XXX _____C
5 Finalize Development of Mathematical Descriptions for Use in MEOR Predictive Simulator — ____ XXX XXX XXX XXX XXX XXX _____C
6 Provide Support to DOE's Cooperative Effort with Venezuela by Presenting Project Research Results at Annex XIII Meetings — _____C
7 Topical Report Describing Development of Mathematical Descriptions for Predicting Mechanisms of Microbial Oil Recovery — _____C

BE3. DEVELOPMENT OF IMPROVED MICROBIAL FLOODING METHODS

Accomplishments

The FY93 objectives of this project are (1) to continue development of an engineering methodology for use in the design and application of microbial methods and (2) to improve oil recovery methods and refine modeling procedures for predicting the effectiveness of such methods in field applications.

Different types of microorganisms can improve oil recovery in various ways. NIPER's research has focused primarily on surfactant and gas-producing microbes that are capable of improving microscopic oil displacement efficiency. Microorganisms can also be used to plug high-permeability zones and cause fluid diversion. During the past 2 years, microbial retention experiments have been conducted with surfactant and gas-producing microbes to determine the effects of microbial adsorption and clogging in porous media. These experiments have been used to define parameters and values for the numerical MEOR simulator.

Research for FY93 will continue with laboratory experiments designed to meet both near- and mid-term objectives. Based upon the laboratory data, mathematical models are being developed to predict microbial transport, metabolism, oil recovery, and permeability modification. The resulting models can then be used to predict the behavior of microbial EOR processes under actual reservoir conditions. Injection strategies for maximizing incremental oil recovery are also being developed.

Milestone 2—A coreflood experiment is in progress using a microbial species of *Leuconostoc*. This species produces polymer when fermenting sugar and should not produce gas in the coreplug. By comparing NMR images obtained during this coreflood with previously acquired images in corefloods using gas-producing microbes, it may be possible to determine and quantify gas distribution in the pores. The results of this experiment will not be available until next month.

Milestone 3—A coreflood was conducted with a polymer-producing microorganism to compare the results of oil recovery efficiency and pressure drop across the core during waterflooding with results obtained previously using NIPER 6 *Clostridium*—a producer of gas, acids, and surfactant. Results with the polymer-producer showed no significant pressure drop increase across the core compared to NIPER 6. The experiment will be repeated with another polymer-producing microorganism using a longer shut-in time.

Milestone 4—The chapter on microbial EOR processes for the NIPER final report has been written and is in review.

A paper, entitled "Basics of Microbial EOR Processes," has been prepared for presentation at the New Technology for Independent Producers seminar to be held in Denver, CO, May 6-7.

Milestone 5—Evaluation of the retention test data continued this month. Problems encountered with the glass beadpack have been resolved, and it can now be used for a retention test using NIPER 6 microbial species.

Manpower and Financial Status

Manpower and financial expenditures are on schedule.

Status of Project Milestones

Project milestones are on schedule.

BE4A

FINANCIAL STATUS OF THE PROJECT FOR APRIL

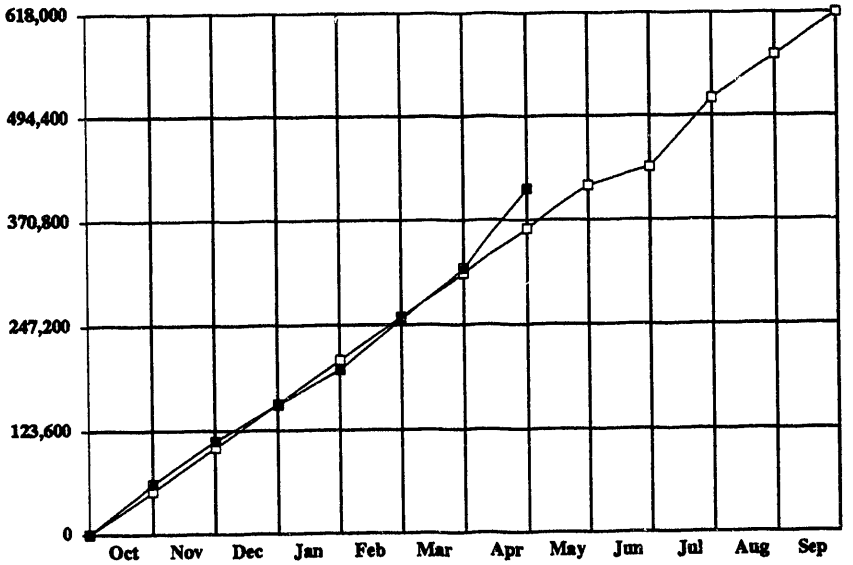
Total Appropriation:		640,000
Less Capital Equipment:	22,000	
Appropriation Balance:	618,000	
Expenditures for the Month:		93,991
Total Expenditures to Date:		407,620
Net Available:		232,380

Capital Equipment Expenses and Commits:

Annual Plan Project BE4A

Development of Improved Chemical Flooding Methods

Financial Status

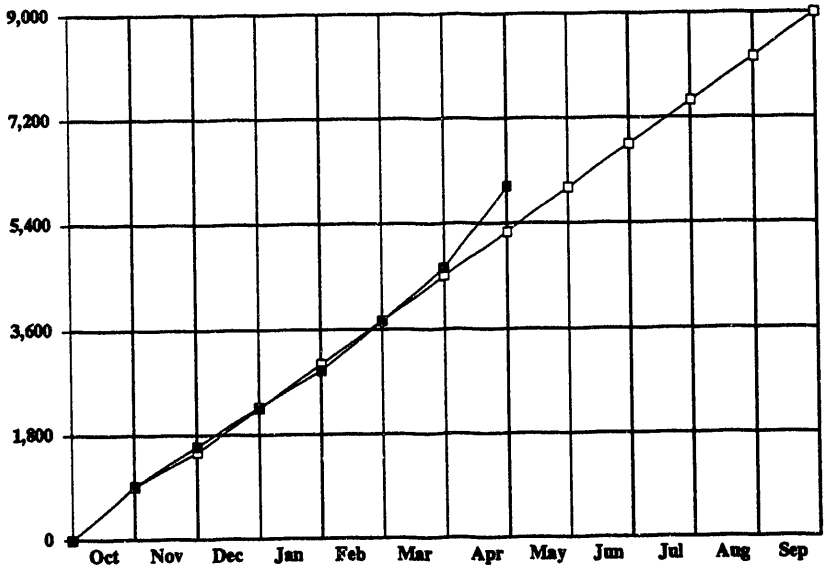


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	51	103	155	206	257	309	361	412	434	515	567	618
Actual	60	111	154	195	254	314	408					
Variance	-9	-8	1	11	3	-5	-47	412	434	515	567	618

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		9,000
Man-hours used this Month:	1,388	
Total Man-hours used to Date:		6,023
Net Available:		2,977

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	906	1500	2250	3000	3750	4500	5250	6000	6750	7500	8250	9000
Actual	913	1606	2268	2891	3743	4635	6023					
Variance	-7	-106	-18	109	7	-135	-773	6000	6750	7500	8250	9000

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C' = Revised Completion Date
C'' = Completed Ahead of Schedule

Key Milestone Status

1 Status Report on Environmental, Safety, and Health Review
2 Evaluation of Mixed Surfactants for use in Class 1 Reservoirs
3 Through CT-Imaged Coreflood Experiments, Determine Effectiveness of Mixed Surfactant Systems for Oil Recovery
4 Determine Adsorption Characteristics of Mixed Surfactant Systems
5 Conduct CT-Imaging Experiments to Determine Optimum Injectant Slug Size for Oil-bank Formation and Mobilization
6 Develop Surfactant Data Base to Facilitate Design of Chemical Flooding Systems & Submit Status Report on Its Effectiveness
7 Prepare Chapter for NIPER Final Report (Draft by April 15)
8 Top. Rpt. Describing Adsorption Studies of Mixed Surfactant Systems
9 Top. Rpt. Describing Effectiveness of Mixed Surfactant Systems for Use in EOR

XXX XXC
XXX XXX XXX XXX XXX XXX XXX _____C
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BE4A. DEVELOPMENT OF IMPROVED CHEMICAL FLOODING METHODS

Accomplishments

The objectives of this project are (1) to determine the applicability of advanced EOR technologies, based on mixed surfactant systems, to improve oil recovery from Class 1 and other DOE-targeted reservoirs; (2) to adapt surfactant EOR technology to different salinity and temperature ranges by developing surfactant systems that are tolerant to changes in chemical composition in selected reservoirs; and (3) to develop cost-effective systems for selected applications using low concentration surfactants with alkaline additives or other sacrificial agents. The studies will focus on problem areas which adversely affect performance and economics of chemical EOR and thus achieve a balance between cost and oil recovery effectiveness.

Milestone 2—Salinity scans are being conducted on selected combinations of the anionic surfactant TRS 10-410/IBA and nonionic surfactants in the Genapol and Igepal series, with different alkane hydrocarbons (n-octane, n-decane, and n-dodecane) and at different temperatures. Similar scans are being conducted with the nonionic surfactants alone (at different HLB values) using the different alkanes. These experiments are being performed to quantify and correlate the oil and water solubilization parameters of these surfactant systems and to compare the values of optimal salinity obtained using this method with the results from earlier PIT studies over a range of temperatures from room temperature up to 60° C. Phase behavior observations over the conditions considered will be made over a period of 1 week per temperature. This will give the oil-brine-surfactant mixtures time to equilibrate.

Milestone 3—The minipermeameter was used to determine permeability variations in an oil-wet core from North Burbank Unit, Osage County, Oklahoma. Average air permeability of this core was approximately 50 mD. The core appeared to be relatively uniform before cleaning. However, after cleaning, a narrow, dark band extended through the core. Average permeability in the area of the dark band ranged from 10 to 14 mD. Regions of higher permeability (50 to 65 mD) could be found on either side of the band. Thin sections will be prepared to determine mineralogical differences that might account for the color change during cleaning. This core is being prepared for evaluation of the effect of iododecane (an oil additive to increase the CT-density of the oil phase during chemical coreflood experiments) on oil saturation distribution calculations using oil-wet core.

Milestone 4—The primary objective of this milestone is to determine the adsorption behavior of mixed surfactant systems. The system currently being tested consists of a 1:1 mixture of Stepan's B-100 (anionic surfactant) and Igepal DM-530 (nonionic surfactant) at a total surfactant concentration of 2%. The adsorbent is Davison Grade 62 silica gel, with a specific surface area of 330 m^2/g. Preparation of calibration curves for the analytic technique using these mixed surfactants is near completion. Preliminary bottle adsorption tests of the unmixed surfactants indicate that the nonionic surfactant will adsorb to the extent of 500-600 milligrams surfactant per gram of solid, while the anionic adsorption is in the range of 0.8 to 1.0 gram surfactant per gram of solid. Static tests are underway to determine the adsorption characteristics of these surfactant mixtures.

Milestone 5—Two CT-monitored corefloods were designed to determine the effect of changing surfactant slug injection size (at constant polymer concentration) on oil-bank formation and propagation. Surfactant slug sizes of 0.4 and 0.2 PV of a 0.4% total-concentration mixed surfactant system were used. Problems occurred with polymer injection during the test using the 0.4 PV system in that the concentration of polymer was only 500 ppm rather than the designed concentration of 3,500 ppm. As a result, this test will have to be repeated.

Milestone 6—Work on the surfactant data base is continuing. A subset of 175 references has been selected for critical review. Detailed information on 30 of these references has been entered into the data base.

Milestone 7—The first draft of the chemical flooding research chapter for the NIPER final report has been completed and submitted for editorial review.

Manpower and Financial Status

Manpower and financial expenditures are higher than planned because of efforts of senior staff personnel in completing the first draft of the 10-year final report.

Status of Project Milestones

Project milestones are on schedule.

BE4B

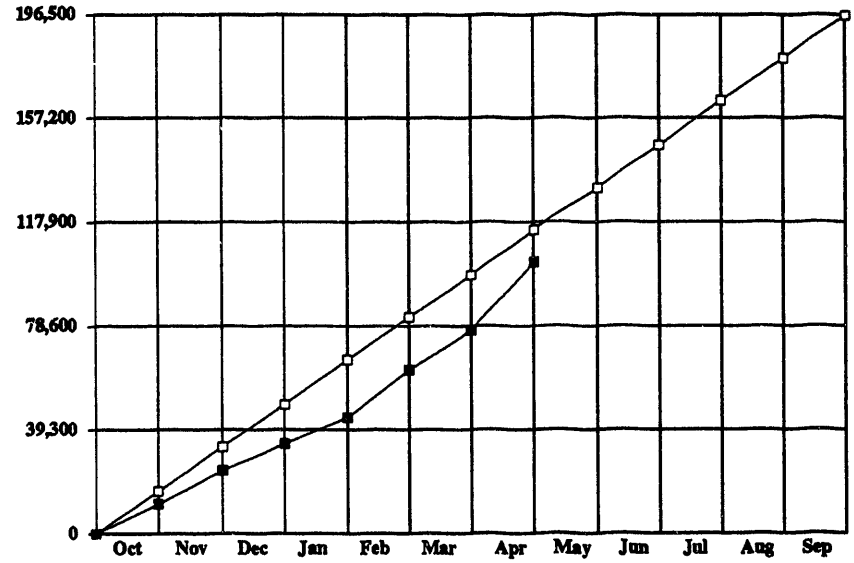
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		200,000
Less Capital Equipment:	3,500	
Appropriation Balance:	196,500	
Expenditures for the Month:		25,669
Total Expenditures to Date:		102,923
Net Available:		97,077
Capital Equipment Expenses and Commits:		2,665

Annual Plan Project BE4B

Development of Improved Alkaline Flooding Methods

Financial Status

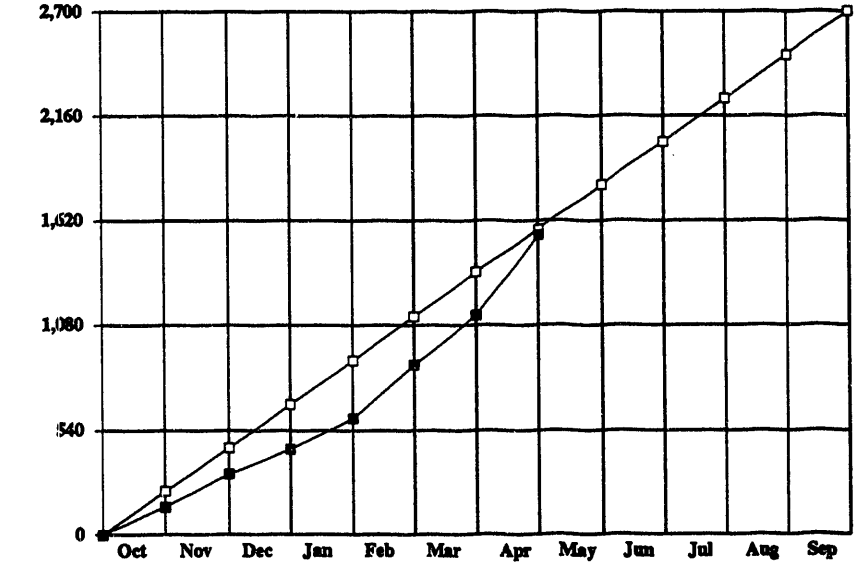


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	16	33	49	66	82	98	115	131	147	164	180	196
Actual	11	24	34	44	62	77	103					
Variance	5	9	15	22	20	21	12	131	147	164	180	196

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		2,700
Man-hours used this Month:	410	
Total Man-hours used to Date:		1,540
Net Available:		1,160

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	225	450	675	900	1125	1350	1575	1800	2025	2250	2475	2700
Actual	146	314	444	602	877	1130	1540					
Variance	79	136	231	298	248	220	35	1800	2025	2250	2475	2700

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C"= Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Project Environmental, Safety, and Health Assessment
2 Conclude Study on Dispersion/Interactions Associated with Surfactant-Enhanced Alkaline Flooding Systems
3 Complete Transfer of Surfactant-Enhanced Alkaline Flooding Technology to Independent Oil Producers
4 Prepare Chapter for NIPER Final Report Summarizing Accomplishments of Project BE4B (Draft Complete by April 15)
5 Topical Report Describing Characteristics of Dispersions Associated with Surfactant & Alkaline Chemical Systems

XXC

XXX XXX XXX XXX XXX XXX XXX _____C

XXX XXX XXX XXX XXX XXX XXC"

_____XXX XXX XXX XXX _____C

_____C

BE4B. DEVELOPMENT OF IMPROVED ALKALINE FLOODING METHODS

Accomplishments

The objectives of this project are to develop improved alkali-surfactant flooding systems and to provide support for an SGP field project. The specific objectives for FY93 are to improve the stability of alkali-surfactant flooding systems by designing combinations of chemicals that will curtail the loss of surfactant from chemical interactions. Most of the tests are being performed with crude oil from the Tucker sand (a Cherokee group sand) of Hepler (KS) oil field, the site of a alkaline/surfactant/polymer field project.

Milestone 2—The BPO approved a change in the objective of this milestone because it was found that characterization of dispersions typical of surfactant-enhanced alkaline systems was more complicated and time intensive than anticipated. The revised objective incorporates the use of CT scanning for the accurate determination of oil saturations in field cores partially swept with surfactant-enhanced alkaline chemical formulations. This research is necessary because heterogeneities in midcontinent field cores make it difficult to predict accurately the final oil saturations that result after application of chemical flooding methods.

A core from Hepler (KS) oil field, which was previously characterized by minipermeameter measurements, was selected for further study. This core was selected because it had a more uniform permeability distribution (between 100 to 225 mD) than many cores from Hepler field, and thus had better potential for good sweep efficiency during chemical flooding.

The interfacial tension (IFT) between oil and injected fluids was measured using a surfactant concentration of 0.1% Chevron CF-100 surfactant, which is a lower surfactant concentration than was used for prior chemical floods with Hepler oil and core. Surfactant concentration was reduced in an effort to improve economics and reduce front-end costs during the field pilot test. Minimum IFT was about 90 μN/m, and was fairly insensitive to the $NaHCO_3$ concentration.

Injection and propagation of a slug of brine (0.3 PV) containing NaI tracer was monitored with the CT scanner. The results indicated considerable dispersion, but gross channeling of injected fluid was not observed. After displacement of the tracer-containing slug, the core was oil flooded to residual water saturation and again monitored by CT. Brine was displaced by the oil without observing any gross channeling. The next step will be to waterflood, followed by chemical flooding.

Milestone 3—Completed.

Milestone 4—Final report preparation was continued with a written section on the accomplishments of surfactant-enhanced alkaline flooding research during this year, which will be a part of Chapter 4 of the NIPER final report.

Manpower and Financial Status

Manpower and financial expenditures are on schedule.

Status of Project Milestones

Milestone 3 was completed in March with presentation of project results at the Tenth TORP conference in Wichita, KS, and at the FDD sandstone reservoir workshop in Norman, OK. The other project milestones are on schedule.

BE4C

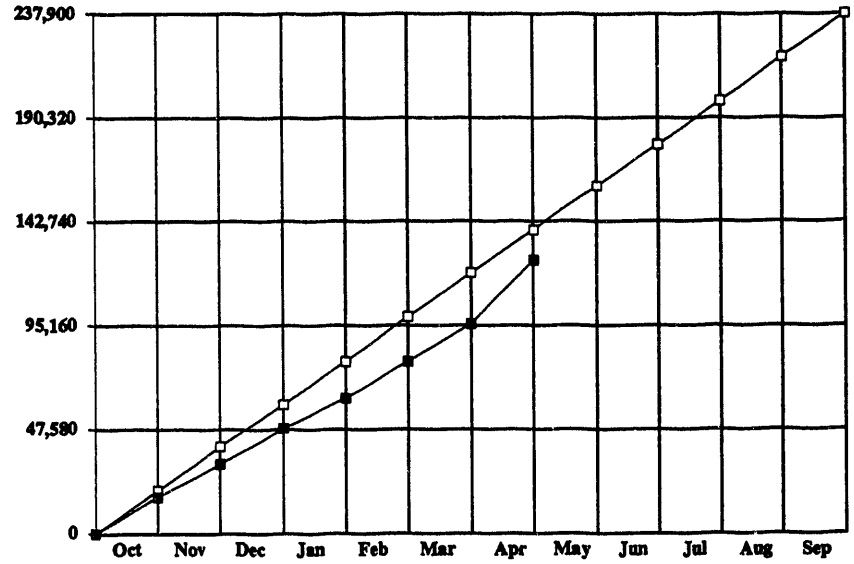
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		240,000
Less Capital Equipment:	2,100	
Appropriation Balance:	237,900	
Expenditures for the Month:		28,560
Total Expenditures to Date:		124,572
Net Available:		115,428
Capital Equipment Expenses and Commits:		0

Annual Plan Project BE4C

Mobility Control and Sweep Improvement in Chemical Flooding

Financial Status

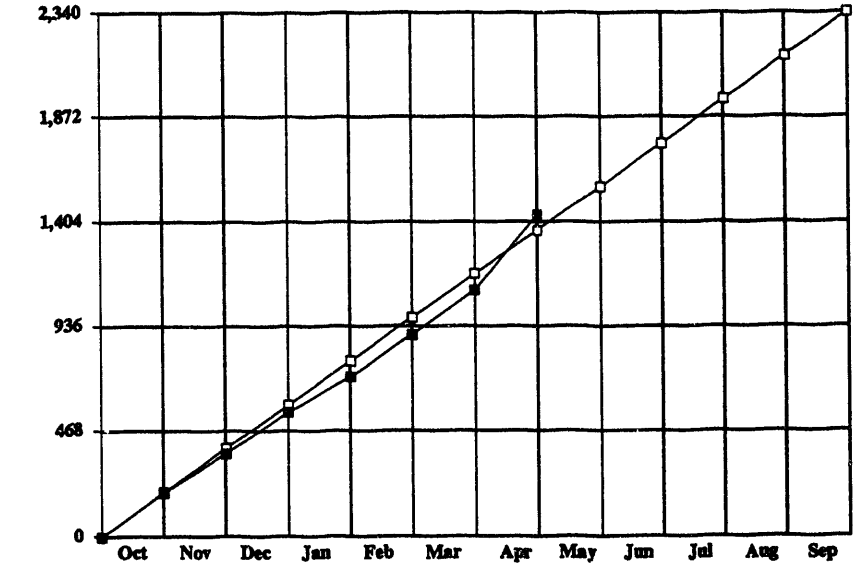


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	20	40	59	79	99	119	139	159	178	198	218	238
Actual	17	32	48	62	79	96	125					
Variance	3	8	11	17	20	23	14	159	178	198	218	238

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		2,340
Man-hours used this Month:	339	
Total Man-hours used to Date:		1,436
Net Available:		904

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	195	390	585	780	975	1170	1365	1560	1755	1950	2145	2340
Actual	192	368	554	710	897	1097	1436					
Variance	3	22	31	70	78	73	-71	1560	1755	1950	2145	2340

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C' = Revised Completion Date
C'' = Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Environmental, Safety, & Health Review — XXC
2 Complete Determination on the Effect of Lamination Angle & Pore Size Distribution on Polymer Retention — XXX XXX XXX XXX XXX XXX XXX _____C
3 Finalize Comparison of Simulation Results from Permeability Modification Simulator with Field Performance Data — XXX ____ XXX XXX XXX XXX XXX _____C
4 Finalize Adaptation of Permeability Modification Simulator to IBM-PC/80386 Microcomputer — _____C
5 Prepare Chapter for NIPER Final Report (Draft by April 15) — _____XXX XXX XXX _____C
6 Status Report Describing the Simulation & Prediction of Oil Recovery from Field Permeability Modification Treatments — _____C
7 Topical Report Describing the Effect of Lamination Angle & Pore Size Distribution on Polymer in Unfired Berea Cores — _____C
8 Complete Source Code, Executable Code, & User's Manual for IBM-PC\80386 Version of Permeability Modification Simulator — _____C

BE4C. MOBILITY CONTROL AND SWEEP IMPROVEMENT IN CHEMICAL FLOODING

Accomplishments

The objectives of this project are to develop improved methods for maintaining effective mobility control throughout the reservoir in chemical flooding and to use NIPER's permeability modification simulator to design a cost-effective gel treatment using polymer gel systems. Specific objectives in FY93 are (1) to determine the effect of lamination angle on polymer retention in unfired Berea cores, (2) to compare simulation results using the permeability modification simulator with field performance, and (3) to convert the permeability modification simulator for use with an BM-PC/80386 or compatible microcomputer.

Milestone 2—Brine permeability measurements and a coreflood were conducted on an unfired rectangular Berea sandstone core to determine the permeability and level of polymer retention. The core had dimensions of 23.88 x 3.81 x 3.81 cm and was cut at 30° from the direction of laminations. The porosity was 19% and brine permeability was 160 mD. The brine was made with 2% KCl. A 3.5 PV (232 mL) slug of a 1,000-ppm biopolymer solution in 2% KCl was then injected and followed by 9.93 PV (657 mL) of 2% KCl. The injection rate used was 3.8 mL/hr or 1.08 ft/d (apparent shear rate = 10 sec^{-1}). Results showed that the maximum amount of polymer retention during polymer flow was 1,143 kg/acre/m, compared to 1,200 kg/acre/m in an unfired Berea sandstone core that was cut along the direction of laminations. This amount was 40% higher than that in a similar but fired Berea core (816 kg/acre/m). The post-brine flood showed that irreversible polymer retention was 370 kg/acre/m, which was lower than that in an unfired Berea sandstone core (402 kg/acre/m) also cut along the direction of laminations.

Milestone 3—Analysis of the field data from a pilot field that had been treated with gelled polymer showed that more information on the top zone would be required in order to determine the permeability distribution. This additional information was requested from an independent oil producer.

Milestone 5—The first draft of the mini-summary and analysis of research results on polymer flooding and permeability modification obtained during the past 9 years, along with recommendations for future research on polymer flooding and permeability modification, has been completed and is in review.

Manpower and Financial Status

Manpower and financial expenditures are on schedule.

Status of Project Milestones

Project milestones are on schedule.

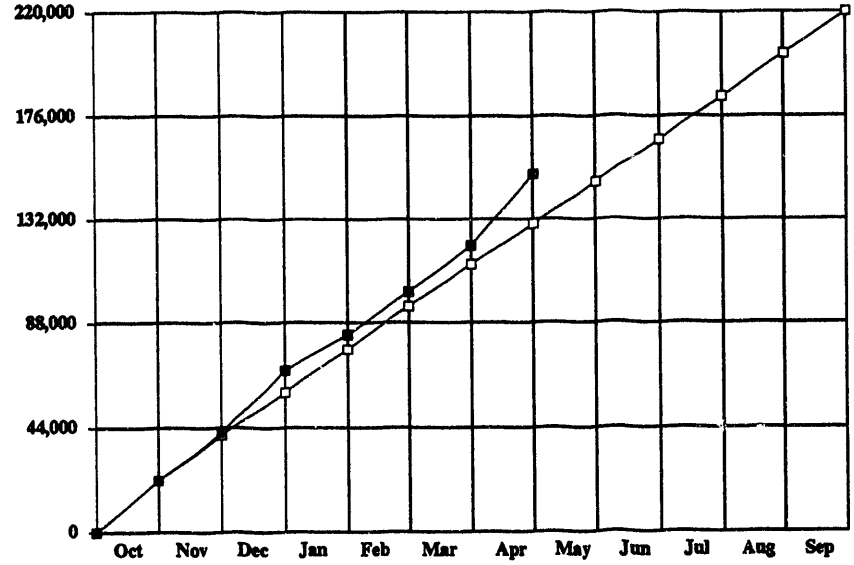
BE5A

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		250,000
Less Capital Equipment:	30,000	
Appropriation Balance:	220,000	
Expenditures for the Month:		30,057
Total Expenditures to Date:		150,939
Net Available:		99,061
Capital Equipment Expenses and Commits:		7,916

Annual Plan Project BE5A

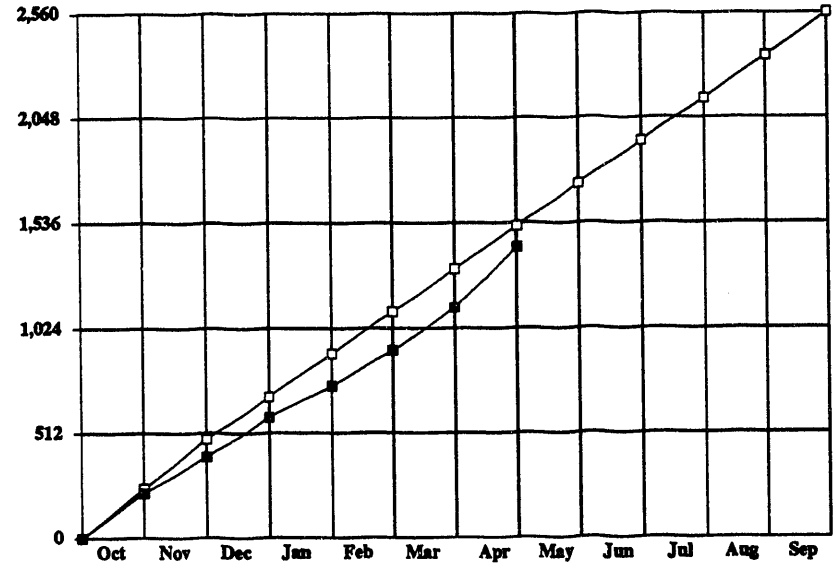
Gas Flood Performance Prediction Improvement



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	22	41	59	77	95	113	130	148	166	184	202	220
Actual	22	42	68	83	101	121	151					
Variance	0	-1	-9	-6	-6	-8	-21	148	166	184	202	220

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		2,560
Man-hours used this Month:	287	
Total Man-hours used to Date:		1,415
Net Available:		1,145



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	240	484	691	898	1106	1313	1520	1728	1935	2142	2350	2560
Actual	220	395	591	743	914	1128	1415					
Variance	20	89	100	155	192	185	105	1728	1935	2142	2350	2560

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C' = Revised Completion Date
C'' = Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Environmental, Safety, and Health Review — XXX XXC

2 Complete Construction & Testing of High-Pressure IFT Measurement Apparatus — ____ XXX XXX XXX XXX XXC

3 Finalize Studies on PVT Determination of Carbon Dioxide Partitioning Between Hydrocarbon & Water Phases at Selected Temperature & Pressure Conditions — ____ XXX XXX XXX XXX XXX XXX _____C

4 Complete IFT Measurements for Water-Hydrocarbon Systems — _____ XXX _____C

5 Prepare Chapter for NIPER Final Report Summarizing Accomplishments of Project BE5A (Draft Complete by April 15) — _____ XXX XXX _____C

6 Topical Report Describing Experimental Techniques & Correlations Developed for IFT and Carbon Dioxide-Partitioning Measurements — _____C

BE5A. GAS FLOOD PERFORMANCE PREDICTION IMPROVEMENT

Accomplishments

The objective of this project is to improve prediction techniques for gas miscible displacement through fundamental research in displacement mechanisms. The FY93 studies are to determine (1) the effects of CO_2 partitioning in oil and water phases and (2) the significance of CO_2 dissolution on water-oil interfacial tension (IFT) and relative permeability.

Milestone 3—Before completing IFT measurements of CO_2 systems, the solubilities of CO_2 in the aqueous and oil phases have to be determined. To this end, a prediction technique for CO_2 solubility in water and brine is being developed.

Milestone 4—Calibration of the equipment for measuring IFT is in progress. The surface tension of pure water at 10° to 40° C and the IFT of n-pentane with water at 25° C have been measured successfully and match data reported in the literature. However, the present repeatability of some measurements is unacceptable, and additional tests will be required to assure the IFT measuring method can provide reliable and reproducible data.

Milestone 5—The revised draft of the chapter on gas flooding research has been prepared and is in review.

Manpower and Financial Status

Manpower utilization is on schedule, but financial expenditures are high by 16% due to concentrated efforts in developing the IFT apparatus and prediction techniques.

Status of Project Milestones

Milestones 1 and 2 have been completed. The other milestones are on schedule.

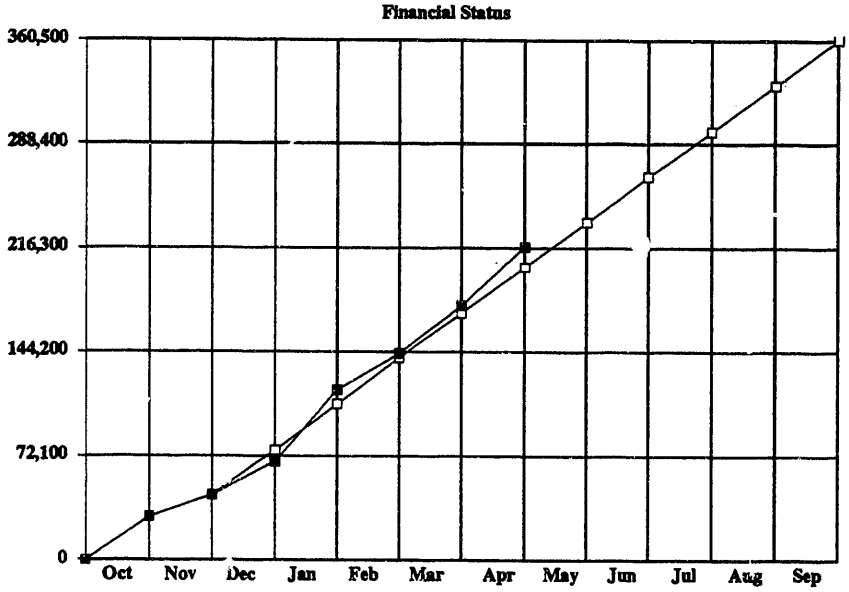
BE5B

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		375,000
Less Capital Equipment:	14,500	
Appropriation Balance:	360,500	
Expenditures for the Month:		41,617
Total Expenditures to Date:		217,419
Net Available:		157,581
Capital Equipment Expenses and Commits:		0

Annual Plan Project BE5B

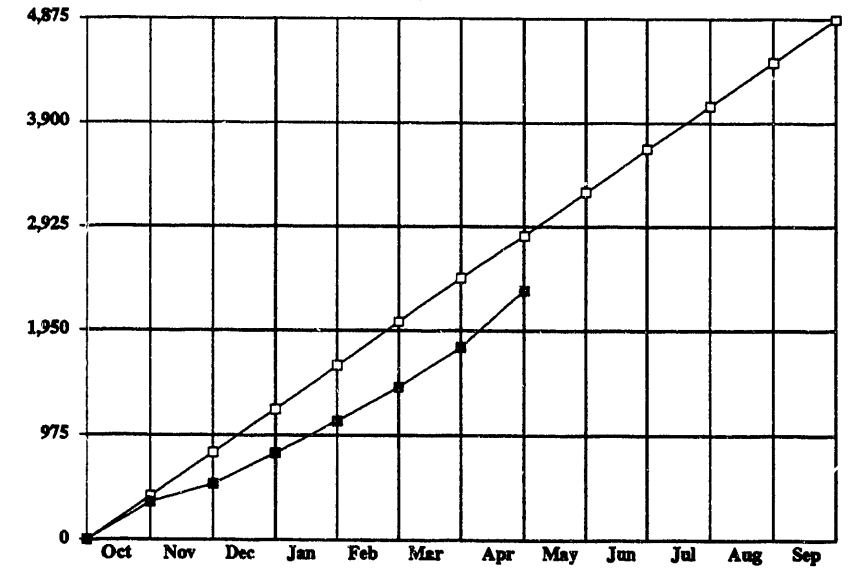
Mobility Control, Profile Modification,
and Sweep Improvement in Gas Flooding



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	30	45	76	108	140	171	203	234	266	297	329	361
Actual	30	45	68	118	143	176	217					
Variance	0	0	8	-10	-3	-5	-14	234	266	297	329	361

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		4,872
Man-hours used this Month:	531	
Total Man-hours used to Date:		2,322
Net Available:		2,550



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	406	812	1218	1624	2030	2436	2842	3248	3654	4060	4466	4872
Actual	354	516	807	1107	1423	1791	2322					
Variance	52	296	411	517	607	645	520	3248	3654	4060	4466	4872

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C' = Revised Completion Date
C'' = Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Project Environmental, Safety, and Health Assessment	XXX XXC
2 Complete Feasibility Evaluation on Use of Alcohol-Induced Salt Precipitation for Profile Modification; Determine Phase Behavior & Salt Precipitation of Alcohol-brine Systems	XXX XXX XXX XXX XXC
3 Complete Studies on Plugging of Porous Media by Alcohol-Induced Salt Precipitation	_____XXX XXX XXX XXX XXX XXX _____C
4 Prepare Chapter for NIPER Final Report Summarizing Accomplishments of Project BE5B (Draft Complete by April 15)	_____XXX XXX XXX _____C
5 Complete Profile Modification Determinations Using Polymer Gels and/or Alcohol-Induced Salt Precipitation	_____XXX _____C
6 Status Report Describing Results of Profile Modification Studies	_____C

BE5B. MOBILITY CONTROL, PROFILE MODIFICATION, AND SWEEP IMPROVEMENT IN GAS FLOODING

Accomplishments

The objective of this project is to develop methods for improving sweep efficiency in gas flooding. Proposed methods for profile modification include the use of polymers, in situ formation of polymer gels, and by precipitation of salts and chemicals.

Milestone 3—Coreflood tests with salt precipitate and ethanol are continuing in order to determine the effects of longer intervals of shut-in time on increased crystal growth and improved permeability reduction. Shut-in times of several weeks duration appear to gradually decrease the permeability.

Other corefloods were conducted with cores at irreducible oil saturation. The cores were then treated with saturated brine and 10% PV ethanol and shut in for 5 days. A waterflood following the brine/ethanol treatment did not produce any additional oil. These corefloods will be continued using a larger quantity of ethanol.

Milestone 4—A draft final report for gas flooding research has been prepared and is in review.

Milestone 5—Testing continued on other polymer systems having potential as profile modification agents for CO_2 flooding. Preliminary tests were made with Curdlan. This biopolymer is soluble only in basic solutions. Solutions of Curdlan thickened and increased in viscosity by decreasing the solution pH. For example, solutions of 0.5% polymer in 1.0 and 0.1 N NaOH had viscosities of 2 and 9 cP, respectively. A gel was formed at a pH of about 9. CO_2 was contacted with the polymer solution to decrease the solution pH, and the gaseous CO_2 reduced the solution pH sufficiently to form a stable gel. About 5 pore volumes of gaseous CO_2 were required to form a gel with a 0.1 N NaOH solution. Properties of this polymer may be useful for profile modification of high-permeability zones in the formation. These properties include a low solution viscosity during injection, and a gel formation when the solution is contacted by the CO_2 flood. However, the desirable property of low viscosity during injection would initially require a highly basic polymer solution.

Manpower and Financial Status

Financial expenditures are on schedule. Manpower is temporarily below planned projections due to commitments to other DOE projects.

Status of Project Milestones

Project milestones are on schedule.

BE9

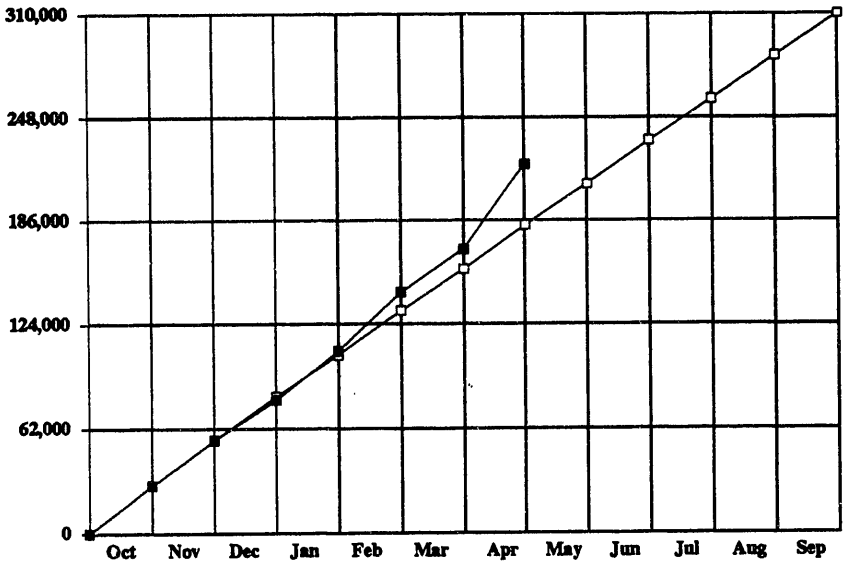
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		340,000
Less Capital Equipment:	30,000	
Appropriation Balance:	310,000	
Expenditures for the Month:		50,153
Total Expenditures to Date:		219,647
Net Available:		120,353
Capital Equipment Expenses and Commits:		4,745

Annual Plan Project BE9

Three-Phase Relative Permeability Research

Financial Status

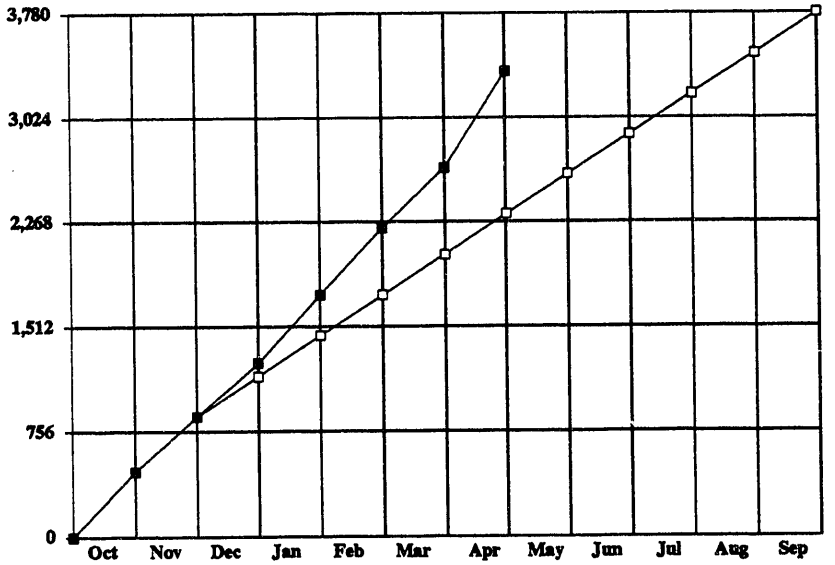


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	29	55	81	106	132	157	183	208	234	259	285	310
Actual	29	55	79	108	143	169	220					
Variance	0	0	2	-2	-11	-12	-37	208	234	259	285	310

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		3,780
Man-hours used this Month:	695	
Total Man-hours used to Date:		3,355
Net Available:		425

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	466	864	1156	1447	1739	2030	2322	2614	2905	3197	3488	3780
Actual	466	864	1247	1741	2222	2560	3355					
Variance	0	0	-91	-294	-483	-630	-1033	2614	2905	3197	3488	3780

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Environmental, Safety, and Health Assessment — XXX XXC

2 Complete Multiphase Relative Permeability Tests at 150 Degrees F on Almond Formation Rock — XXX ____ XXX XXX XXC

3 Select & Characterize Rock for FY93 Experimental Program — ____ XXX XXX XXX XXX XXX _____ C

4 Complete Design of Test Fluid & Equipment for Use in Measuring IFT Under Selected Conditions of Temperature & Pressure — _____ XXX XXX XXX X___ C

5 Conclude FY93 Multiphase Relative Permeability Experiments at Elevated Conditions of Temperature & Pressure — _____ XXX XXX _____ C

6 Complete Development of Coreflood Simulator — _____ XXX XXX ____ XXX _____ C

7 Prepare Chapter for NIPER Final Report Summarizing Project Accomplishments (Draft Complete by April 15) — _____ XXX XXX XXX XXX _____ C

8 Topical Report Describing Two- and Three-Phase Relative Permeability & Other Experimental Results — _____ _____ C

BE9. THREE-PHASE RELATIVE PERMEABILITY RESEARCH

Accomplishments

The objectives of this project are (1) to improve the reliability of laboratory measurements of three-phase relative permeability for steady- and unsteady-state conditions in core samples; (2) to investigate the influence of rock, fluid, and rock-fluid properties on two- and three-phase relative permeabilities; and (3) to expand the state of the art for measuring relative permeabilities at higher temperatures and pressures.

Milestone 3—Capillary pressure tests will be performed next month.

Milestone 4—A fluid system consisting of methane, propane, and bromopropane is in design. Permeameter designs are under evaluation.

Milestone 5—Laboratory flow tests have been designed, and experiments are expected to start during the next reporting period.

Milestone 6—The Gateway 2000 Model 486DX2/66V computer system was received at the beginning of the month. This computer is equipped with 32 MBytes of memory, a 340 MByte hard drive, and a very fast video adapter with a 38.1-cm color monitor. The hard drive and video adapter operate off a VESA local bus system and provide very fast response. The computer is also equipped with a CD-ROM drive and a tape-cartridge drive for backup. The computer was provided with the DOS 5.0 and Windows 3.1 operating systems. The computer has since been equipped with a beta version of the OS/2 2.1 operating system from IBM. While there are a few bugs in this operating system, it appears to be very versatile, being able to run DOS and Windows 3.1 programs together with OS/2 programs with true multi-tasking. All of the software currently available on DOS or Windows 3.1 appears to run with no problems. Two versions of the Microway FORTRAN compilers—one for DOS extenders and one for OS/2 2.x—have been installed on the computer. These have been used to compile a version of the BOAST simulator for both systems. Some time was required to modify the source code to obtain a working simulator.

The compiled BOAST simulator has been tried on several one- and two-dimensional (1-D and 2-D) simulations. On 2-D data sets involving approximately 3,000 grid blocks, the simulator takes about 30 minutes to perform 600 trials before reaching terminating conditions. For a 1-D data set involving 40 grid blocks, the simulator takes 33 seconds to do approximately 1,000 trials before reaching endpoint. During this 33 second run, the simulator output 36 data files showing the 1-D oil, water, and gas saturations and how the flood front traversed the length of the model during the simulation. Now that the simulator is working properly, it will be used to study 1-D and 2-D models based on permeability, porosity, capillary pressure, and saturation distributions representative of real rock systems under study in the laboratory.

Milestone 7—A first draft of the BE9 final report chapter has been completed.

Manpower and Financial Status

Manpower and financial expenditures are above target levels and reflect the effort in meeting the early completion dates for milestones 3 through 6.

Status of Project Milestones

Milestone 3 is on schedule. Milestone 4 is behind schedule and has proven to be more difficult than anticipated. The other milestones are on schedule.

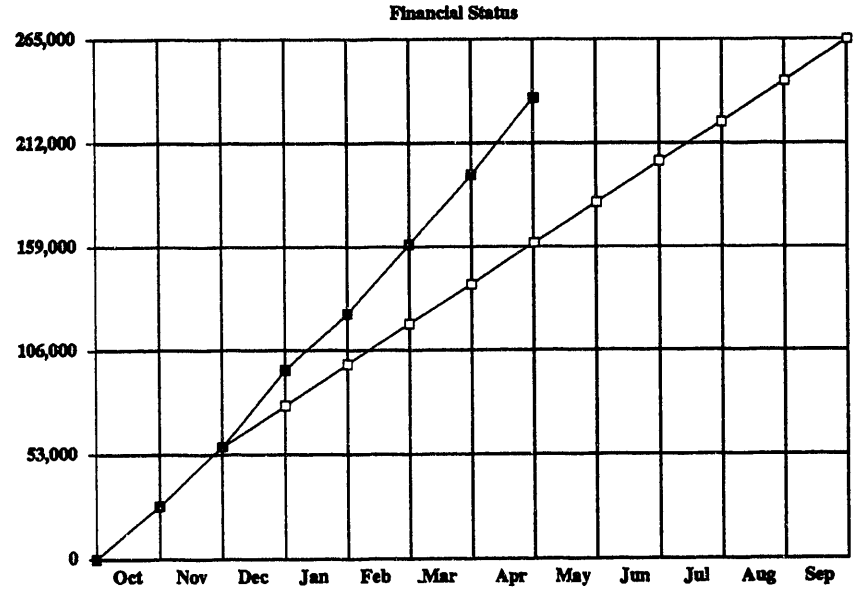
BE11A

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		300,000
Less Capital Equipment:	35,000	
Appropriation Balance:	265,000	
Expenditures for the Month:		39,362
Total Expenditures to Date:		234,871
Net Available:		65,129
Capital Equipment Expenses and Commits:		0

Annual Plan Project BE11A

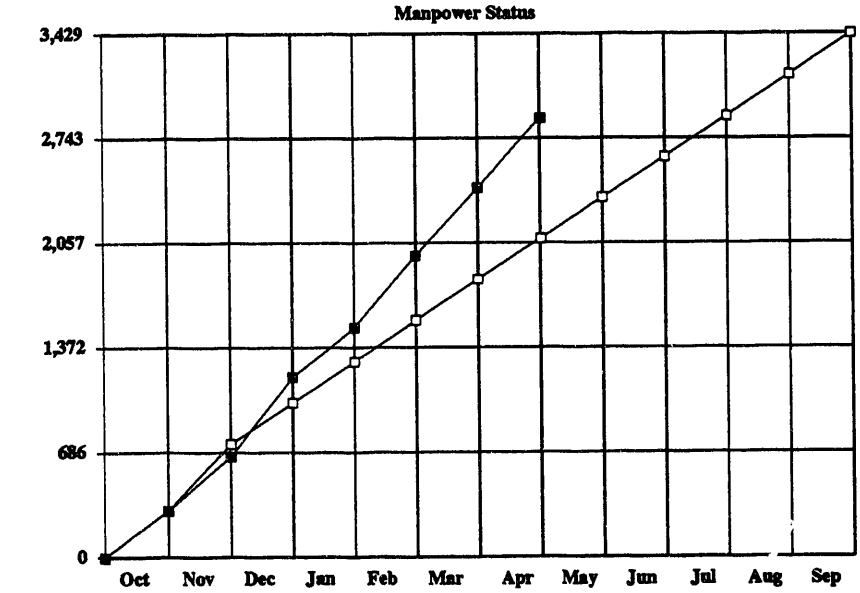
Thermal Processes for Light Oil Recovery



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	27	57	78	99	120	140	161	182	203	223	244	265
Actual	27	57	96	125	160	196	235					
Variance	0	0	-18	-26	-40	-56	-74	182	203	223	244	265

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		3,429
Man-hours used this Month:	457	
Total Man-hours used to Date:		2,875
Net Available:		554



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	305	740	1009	1278	1547	1816	2085	2353	2622	2891	3160	3429
Actual	305	661	1177	1500	1974	2418	2875					
Variance	0	79	-168	-222	-427	-602	-790	2353	2622	2891	3160	3429

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C' = Revised Completion Date
C'' = Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Project Environmental, Safety, and Health Assessment — XXX XXC

2 Topical Report on Assessment of NIPER Thermal EOR Research Program Over Past Ten-Year Period — _____XXX XXX XXX XXX XXC'

3 Complete Supporting Research on Improved Steamflooding at NPR No. 3, Teapot Dome (WY) Field — XXX XXX XXX XXX XXC

4 Develop Procedures & Apparatus for Measuring Dynamic Saturation Changes in Steamflooding Using X-ray & CT-scanning — _____XXX XXX _____XXX XXX XXX _____C

5 Prepare Chapter for NIPER Final Report Summarizing Accmomplishments of NIPER's Thermal EOR Program (Draft by April 15) — _____XXX XXX XXX _____C

6 Complete Transfer of Thermal Technology Developmental Research Through ANNEX IV of the DOE/Venezuelan Cooperative Agreement — XXX _____XXX _____XXX XXC''

7 Topical Report Describing Research on Thermal Processes for Light Oil Recovery — _____XXX XXX XXX _____C

BE11A. THERMAL PROCESSES FOR LIGHT OIL RECOVERY

Accomplishments

The FY93 objectives of this project are (1) to perform an environmental, safety, and health (ES&H) analysis on project tasks; (2) to assess the thermal research performed at NIPER; (3) to develop procedure and apparatus for measuring dynamic saturation changes in steamfloods at field conditions using X-ray and CT scanning and incorporate temperature and pressure measurements to calibrate a numerical simulator for predictive purposes; (4) to conduct laboratory research in support of NPR No. 3, Teapot Dome (WY) field light oil steamflood; and (5) to participate in the Annex IV meetings conducted by the DOE and the Venezuelan Ministry of Energy and Mines.

Milestone 2—In completion of this milestone, a topical report, entitled "Evaluation of NIPER Thermal EOR Research, State of the Art, and Research Needs," (NIPER 675) has been delivered to the BPO. This report summarizes NIPER's thermal recovery research over the past 10 years, analyzes contributions of the research, describes the transfer of the technology to potential users, defines current trends in thermal research and thermal oil production, and identifies areas where NIPER can contribute to future advances in thermal oil production.

Milestone 4—A safety review of the proposed new steamflood laboratory has been undertaken and a draft of the report is being reviewed. Submission of the proposal to NIPER management in May is anticipated.

Milestone 5—A draft of the results of the previous 10 years research at NIPER by the thermal group was prepared as a chapter for inclusion in NIPER's final report. The chapter is in review.

Milestone 7—A topical report on the software for laboratory control, data collection, automation, and analysis is being revised and will be submitted for review in May. This software, designed as NIPER LAB WARDEN, was developed as a general laboratory operating software that can easily be customized to meet individual laboratory or pilot plant applications. The topical report contains a guide to the software operation, a copy of the software, and a section to assist those wishing to customize their applications.

At the request of the BPO, three small business innovative research (SBIR) proposals on oil production technologies were reviewed during April.

Manpower and Financial Status

Manpower and financial expenditures are high by 38 and 46%, respectively, due to work required in preparing the 10-year reports for milestones 2 and 5. Only the DOE contractors review (July 18-22, 1993) and the topical report for milestone 7 remain to be completed.

Status of Project Milestones

Milestones 2 and 6 have been completed. All other milestones are on schedule.

BE11B

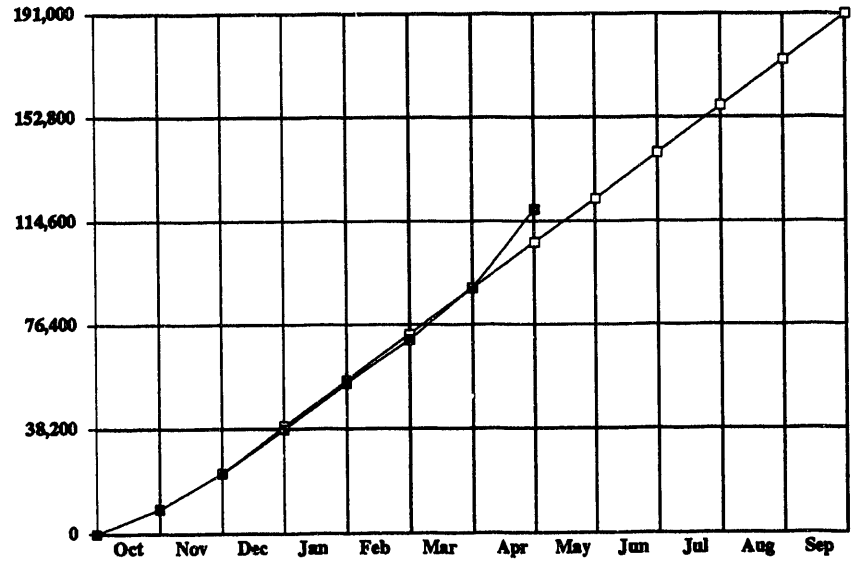
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		200,000
Less Capital Equipment:	9,000	
Appropriation Balance:	191,000	
Expenditures for the Month:		29,129
Total Expenditures to Date:		119,090
Net Available:		80,910
Capital Equipment Expenses and Commits:		0

Annual Plan Project BE11B

Thermal Processes for Heavy Oil Recovery

Financial Status

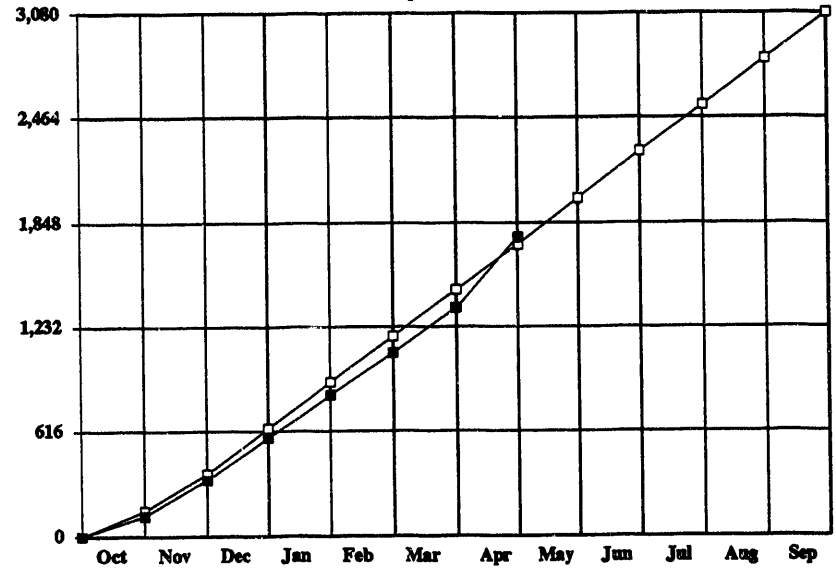


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	9	22	39	56	73	90	107	123	140	157	174	191
Actual	9	22	38	55	71	90	119					
Variance	0	0	1	1	2	0	-12	123	140	157	174	191

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		3,080
Man-hours used this Month:	423	
Total Man-hours used to Date:		1,765
Net Available:		1,315

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	149	362	634	906	1177	1449	1721	1993	2265	2536	2808	3080
Actual	119	328	577	829	1080	1342	1765					
Variance	30	34	57	77	97	107	-44	1993	2265	2536	2808	3080

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C' = Revised Completion Date
C'' = Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Project Environmental, Safety, and Health Review	XXX XXC
2 Complete Screening & Identification of Potential Heavy Oil Reservoirs in Texas Gulf Coast Region; Obtain Rock, Fluid, & Reservoir Data on Most Promising Reservoir	_____XXX XXC
3 Topical Report on Assessment of NIPER Thermal EOR Research Program Over Past Ten-Year Period	_____XXX XXX XXX XXC'
4 Complete Evaluation of Mobil's Steamflood Predictive Model	_____XXX XXX XXX _____C'
5 Complete Modeling Studies to Determine Applicability of Thermal EOR for Recovery of Heavy Oil in Texas Gulf Coast Reservoirs	_____XXX XXX XXX _____C
6 Prepare Chapter for NIPER Final Report (Draft by April 15)	_____XXX XXX XXX _____C
7 Status Report on Results of Predictive Model & Simulation Studies	_____C

BE11B. THERMAL PROCESSES FOR HEAVY OIL RECOVERY

Accomplishments

The FY93 objectives are (1) to analyze the NIPER heavy oil data base to screen Texas Gulf Coast reservoirs for priority ranking and (2) to conduct modeling and reservoir studies to determine the applicability of thermal enhanced oil recovery techniques in Texas Gulf Coast heavy oil reservoirs.

Milestone 3—The topical report for the 10-year assessment of thermal EOR research (NIPER-675) was delivered to BPO and completes work scheduled for this milestone.

Milestone 4—The assessment of Mobil's steamflood prediction model is in progress.

Milestone 5—Numerical simulation of a steamflood in the Taylor-Ina (TX) field is in progress. The feasibility of improving steamflood performance with CO_2 as an additive is being investigated. A literature survey of a steamflood using CO_2 was undertaken to collect the requisite data for simulation. The Computer Modeling Group's phase behavior model (CMG PROP) will be used in modeling the CO_2-steam phase behavior.

Milestone 6—A chapter on thermal EOR research activities for inclusion in NIPER's 10-year report was submitted to NIPER management for review on April 15, 1993.

At the request of BPO, project staff reviewed seven Small Business Innovative Research proposals.

Manpower and Financial Status

Manpower utilization is on schedule, but financial expenditures are high by 11% and reflect staff involvement in preparing the 10-year research report.

Status of Project Milestones

Milestone 3 was completed. The other project milestones are on schedule.

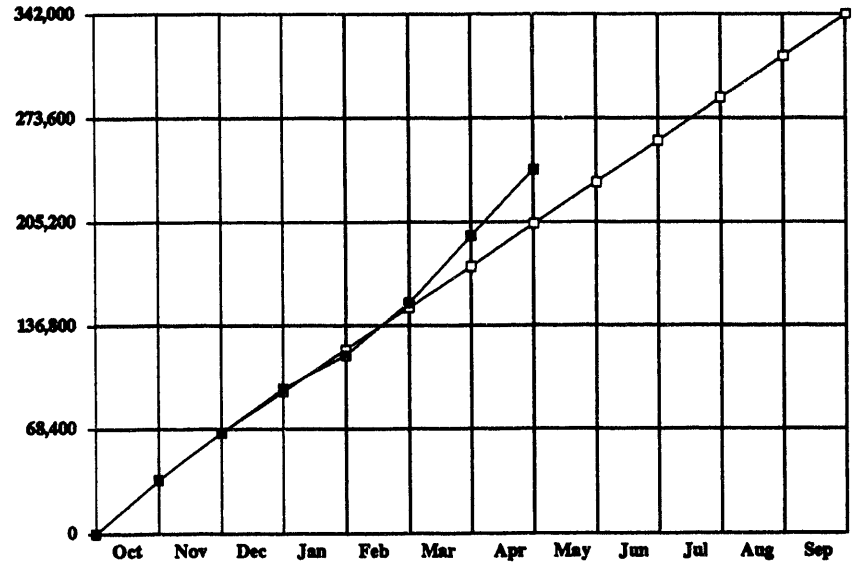
BE12

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		350,000
Less Capital Equipment:	8,000	
Appropriation Balance:	342,000	
Expenditures for the Month:		44,662
Total Expenditures to Date:		240,249
Net Available:		109,751
Capital Equipment Expenses and Commits:		0

Annual Plan Project BE12

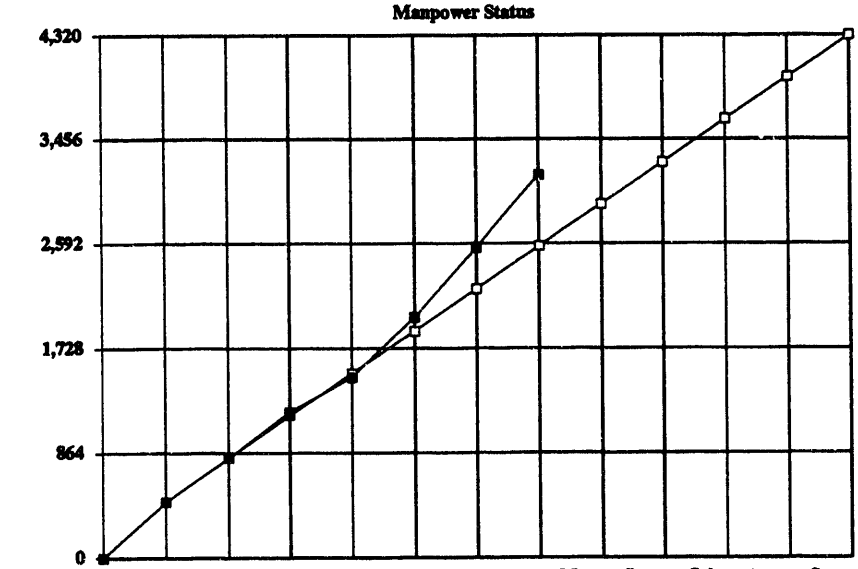
Imaging Techniques Applied to the Study of Fluids in Porous Media



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	35	66	93	121	149	176	204	232	259	287	314	342
Actual	35	66	95	117	152	196	240					
Variance	0	0	-2	4	-3	-20	-36	232	259	287	314	342

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		4,320
Man-hours used this Month:	606	
Total Man-hours used to Date:		3,164
Net Available:		1,156



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	457	821	1171	1521	1871	2221	2571	2920	3270	3620	3970	4320
Actual	457	821	1201	1492	1985	2558	3164					
Variance	0	0	-30	29	-114	-337	-593	2920	3270	3620	3970	4320

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C' = Revised Completion Date
C'' = Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Environmental, Safety, and Health Review — XXX XXC

2 Topical Report Describing Scale-up of Reservoir Rock Types in Class 1 Reservoirs — XXX XXC

3 Complete Investigation on Use of Single- & Multi-energy Scans for Rapid Characterization of Core Samples — XXX XXX XXX XXX _____XX__ XXX _____C'

4 Derive Scale-up Procedures for Determining Permeability & Relative Permeability Values in Large, Heterogeneous Core Samples — XXX XXX XXX XXX XXX XXX XXX _____C

5 Complete Investigation on the Applicability of NMR Spectroscopy & Microscopy for Studying Rock-Fluid Interactions Affecting Wettability — XXX XXX XXX XXX XXX XXX XXX _____C

6 Prepare Chapter for NIPER Final Report (Draft by April 15) — _____XXX XXX XXX _____C

7 Compete Development of Technology Transfer Activity — _____XXX XXX XXX XXX XXX XXX _____C

8 Status Report Describing the Application of NMR Spectroscopy to the Study of Wettability — _____C

BE12. IMAGING TECHNIQUES APPLIED TO THE STUDY OF FLUIDS IN POROUS MEDIA

Accomplishments

The objectives of this project are: (1) to develop and correlate reservoir engineering parameters from petrographic image analysis, computed tomography (CT) scanning, and nuclear magnetic resonance imaging (NMRI); (2) to investigate the applicability of imaging technologies in the development of scale-up procedures from core plug to whole core to interwell scale; (3) to develop an industry consortium or industrial advisory panel organized to help plan, review, and participate in the research through the Work-For-Others program and to provide for effective technology transfer; and (4) to strongly encourage collaborative research by industrial participants.

Milestone 3—Because of the possibility of conducting joint imaging research with a major oil company, a request to extend the completion date of this milestone until July 1 has been submitted to the BPO for approval.

Milestone 4—The drainage cycle for relative permeability measurements in a heterogeneous Tallant sample has been nearly completed. Permeability and saturation distributions for fractional oil flow rates of 0.02, 0.05, 0.1, 0.2, 0.4, 0.7, 0.9 have been measured for the 26 cP oil viscosity, and analysis of the data is in progress. Preliminary analysis indicates a possible correlation between the porosity of various rock laminations and the saturation distributions at the various fractional flow conditions.

Milestone 5—Two sizes of small-bore glass capillary tubing have been acquired for NMRI studies of systems having mixed wettabilities. The smaller-bore tubing, 530-microns OD and 140-microns ID, will be cleaned with acid to achieve water-wet conditions. The larger-bore tubing, 630-microns OD and 210-microns ID, will be converted to an oil-wet condition by heating for several hours (at elevated temperatures) while in contact with oil. By blending the two types of tubing into a bundle using Teflon shrink tubing, NMRI phantoms will be made containing both water- and oil-wet surfaces. These phantoms will be used to investigate the feasibility of using NMR microscopy to identify the wettability of specific locations in systems of mixed wettability. In the NMR images, the nature of the surfaces will be identified by the size of the capillary tubing.

Milestone 6—A first draft of the rock-fluid imaging research chapter (containing results and accomplishments of project BE12 and earlier projects BE12A and BE12B) has been prepared for the NIPER final report.

Milestone 7—A paper, entitled "Imaging Technology Applied to Rock and Fluid Imaging in Cores," will be presented as a part of the series of talks to be given at the New Technology for Independent Producers Workshop, to be held in Denver, CO, May 6-7, 1993. Contacts have continued with three major oil companies regarding cooperative research.

Manpower and Financial Status

Manpower and financial expenditures are higher than planned due to efforts required in meeting the completion dates for milestones 3 and 4.

Status of Project Milestones

A request to extend the completion date for milestone 3 to July 1, 1993, has been approved by the BPO. The other project milestones are on schedule.

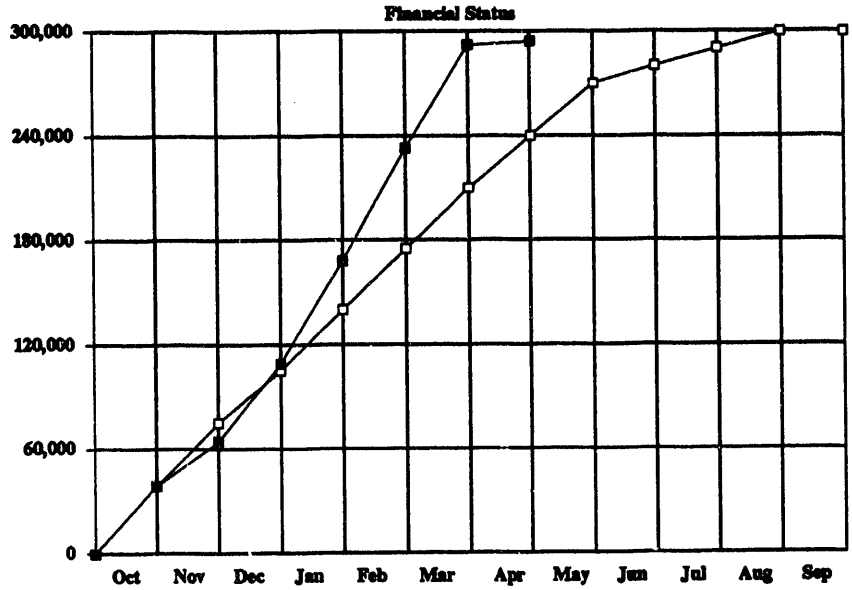
BFR2

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		300,000
Less Capital Equipment:	0	
Appropriation Balance:	300,000	
Expenditures for the Month:		2,110
Total Expenditures to Date:		294,037
Net Available:		5,963
Capital Equipment Expenses and Commits:		0

Annual Plan Project BFR2

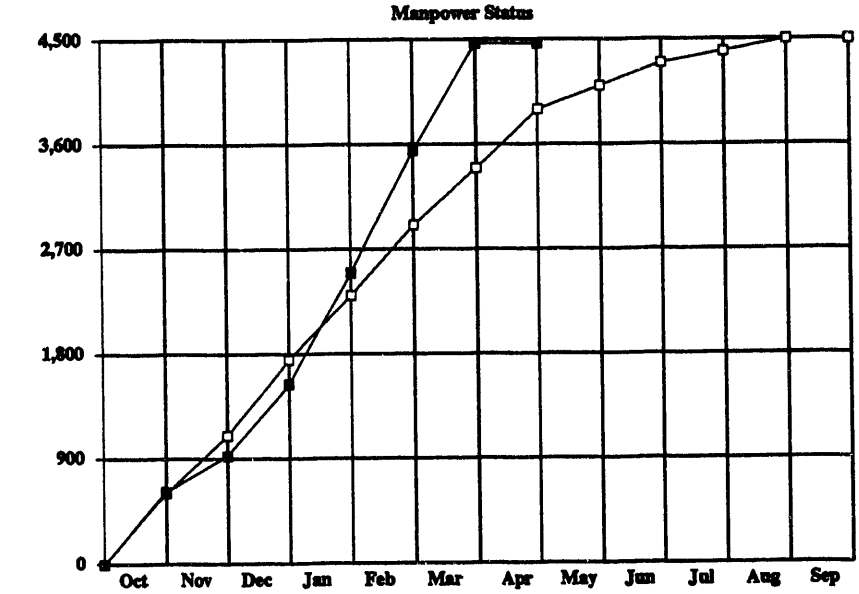
Development of Analytical Methodology
for Analysis of Heavy Crudes



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	39	75	105	140	175	210	240	270	280	290	300	300
Actual	39	64	109	168	233	292	294					
Variance	0	11	-4	-28	-58	-82	-54	270	280	290	300	300

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		4,500
Man-hours used this Month:	0	
Total Man-hours used to Date:		4,470
Net Available:		30



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	600	1100	1750	2300	2900	3400	3900	4100	4300	4400	4500	4500
Actual	614	928	1542	2491	3546	4470	4470					
Variance	-14	172	208	-191	-646	-1070	-570	4100	4300	4400	4500	4500

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Submit Status Report on Project Environmental, Safety, and Health Assessment — XXX XXC

2 Prepare Chapter for NIPER Final Report Summarizing Accomplishments of Project BFR2 (Draft complete by July 30) — _____XXX XXX XXX _____C

3 Complete FY93 Research on Catalytic Cracking of 650 Degree F Resids and Fractions; Submit Topical Report on the Research Results — _____XXX XXX XXX XXX XXX XXX _____C

FUELS RESEARCH

BFR2. DEVELOPMENT OF ANALYTICAL METHODOLOGY FOR ANALYSIS OF HEAVY CRUDES

Accomplishments

Milestone 2—Work on the 10-year summary report has been initiated.

Milestone 3—Cat cracking of Lagomedio >650° F resid, and chromatographic fractions thereof, has been completed. Solid and liquid products from those runs are currently being analyzed. Analysis of Brass River products also has been completed; those data are being entered into the computer for calculation of material balances for those runs.

Manpower and Financial Status

Experimental work has essentially ceased due to the exhaustion of available funds.

Status of Project Milestones

Milestone 2 is on schedule; milestone 3 is ahead of schedule.

BFR3

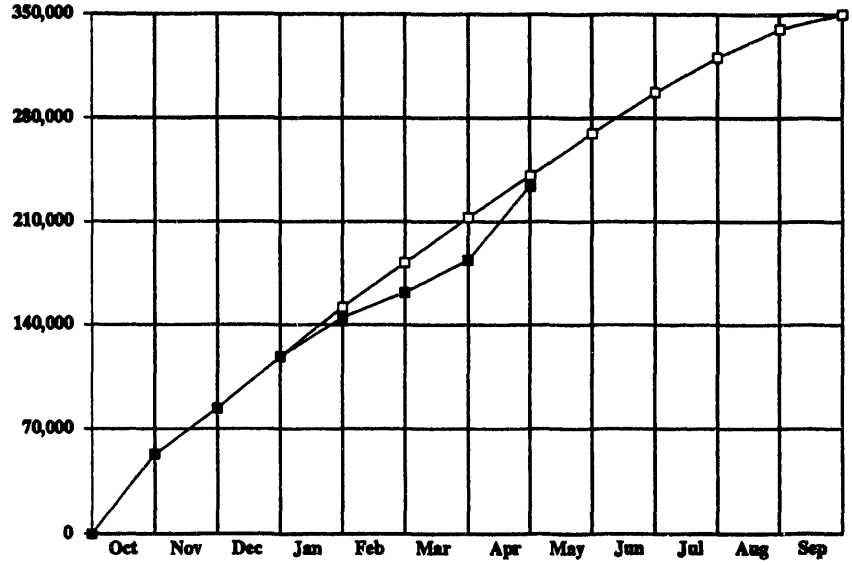
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		350,000
Less Capital Equipment & Sub:	0	
Appropriation Balance:	350,000	
Expenditures for the Month:		50,023
Total Expenditures to Date:		233,649
Net Available:		116,351
Capitol Equipment/Subcontract Exp & Comm		0

Annual Plan Project BFR3

Thermochemistry & Thermophysical Properties of Organic Nitrogen- and Diheteroatom-Containing Compounds

Financial Status

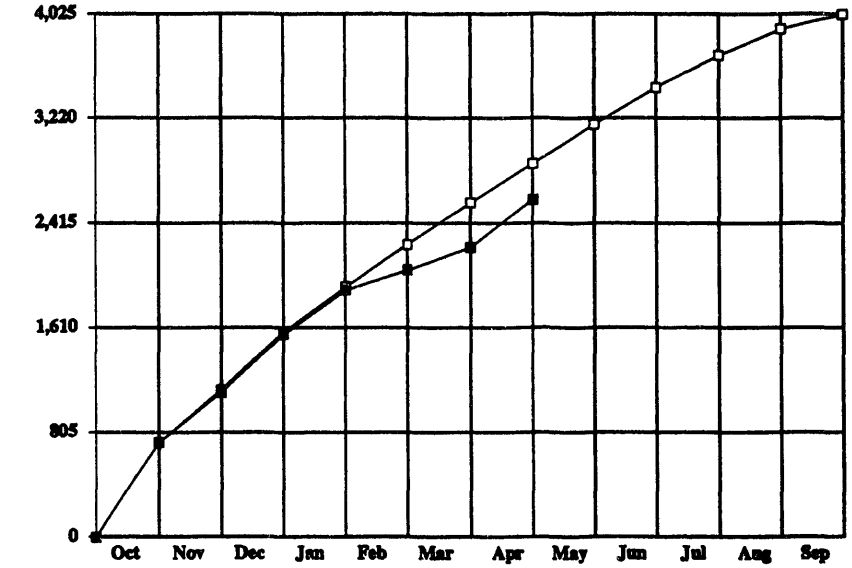


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	53	84	119	152	182	213	241	270	297	321	340	350
Actual	53	84	119	145	162	184	234					
Variance	0	0	0	7	20	29	7	270	297	321	340	350

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		4,022
Man-hours used this Month:	348	
Total Man-hours used to Date:		2,595
Net Available:		1,427

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	724	1133	1572	1922	2247	2572	2872	3172	3462	3712	3912	4022
Actual	724	1113	1552	1899	2052	2227	2595					
Variance	0	20	20	23	195	345	277	3172	3462	3712	3912	4022

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Submit ES&H Report for DOE Review and Action — XXC
2 Conduct Review Meeting with DOE Headquarters — _____ C
3 Complete Three Journal Articles on the Thermodynamic Properties of Nitrogen-Containing Compounds Measured in this Research — XXX XXX XXX XXX XXX XXX XXX _____ C
4 Prepare Chapter for NIPER Final Report Summarizing Accomplishments of Project BFR3 and State of the Art of Fossil Energy Thermodynamics Research — _____ C
5 Topical Report and Computer Software for EPCoP — _____ C

BFR3. THERMOCHEMISTRY AND THERMOPHYSICAL PROPERTIES OF ORGANIC NITROGEN- AND DIHETEROATOM-CONTAINING COMPOUNDS

Accomplishments

Last month, heat capacity and enthalpy studies on 8-methylquinoline were halted for cryostat repairs. Repairs were completed and the cryostat and calorimeter were calibrated. Preparations for reloading 8-methylquinoline into the calorimeter were begun.

A journal article, entitled "The Thermodynamic Properties of Thianthrene and Phenoxathiin," was accepted for publication in the *Journal of Chemical Thermodynamics.*

Writing of the chapter for the NIPER final report on the accomplishments in this research was completed this month.

Preparation of a journal article on the thermodynamic properties of 2-methylaniline and trans-decahydroquinoline continued. Data analyses are now complete. Updating of all of the relevant tables continues. The article will be submitted to the *Journal of Chemical Thermodynamics* during the coming quarter.

Enthalpy of combustion studies on 2-methyl- and 8-methylquinolines continued. These compounds are included in a series of measurements scheduled for completion in this quarter.

Manpower and Financial Status

Manpower and financial expenditures are on schedule.

Status of Project Milestones

The status report to complete the FY92 milestones is in preparation. FY93 project milestones are on schedule.

SGP13

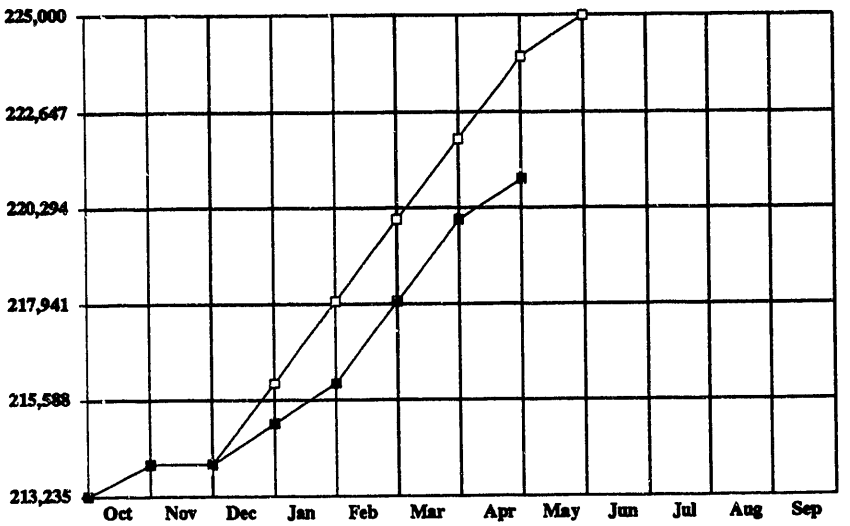
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		419,000
Less Subcontracts:	194,050	
Appropriation Balance:	224,950	
Expenditures for the Month:		1,373
Total Expenditures to Date:		415,254
Net Available:		3,746
Subcontract Expenses:		202,583

Annual Plan Project SGP13

Microbial-Enhanced Waterflooding
Field Project

Financial Status

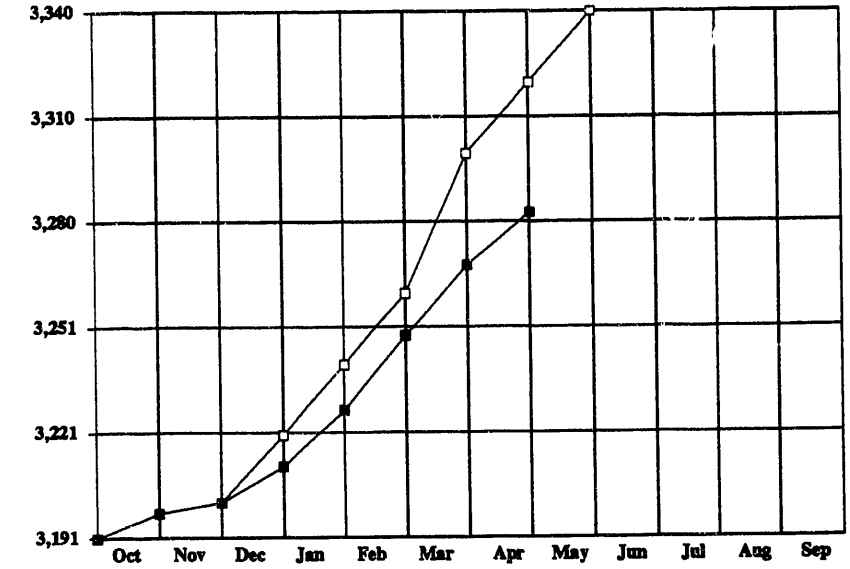


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	214	214	216	218	220	222	224	225				
Actual	214	214	215	216	218	220	221					
Variance	0	0	1	2	2	2	3	225	0	0	0	0

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		3,340
Man-hours used this Month:	15	
Total Man-hours used to Date:		3,283
Net Available:		57

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	3198	3201	3220	3240	3260	3300	3320	3340				
Actual	3198	3201	3211	3227	3248	3268	3283					
Variance	0	0	9	13	12	32	37	3340	0	0	0	0

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Complete Oil Recovery Monitoring Phase; Submit Topical Report Describing Performance of MEOR Field Project

XXX XXX XXX XXX XXX XXX XXX _____C

SUPPLEMENTAL GOVERNMENT PROGRAM

SGP13. MICROBIAL-ENHANCED WATERFLOODING FIELD PROJECT

Accomplishments

The objectives of this project are to determine the feasibility of improving oil recovery in an ongoing waterflood using microorganisms and to expand the initial pilot and determine the economics of microbial enhanced waterflooding.

The site for the expanded MEOR pilot is located in Section 8, Township 24 North, Range 17 E, of Rogers County. This site is part of the Chelsea-Alluwe field in the Bartlesville formation and was initially developed shortly after Delaware-Childers field. The site is currently under waterflood and is owned by Phoenix Oil and Gas Ltd. This field is in a very isolated area, with virtually no other oil-producing leases nearby. Although this field has much in common with the Mink Unit, there are some significant differences. The Phoenix field is not a freshwater flood; the water is recycled and injected and has an average total dissolved solids value of 3%. The permeability of the formation is about 20 mD.

Milestone 1—Fluorescein tracer (100 bbl at a concentration of 126 ppm) was injected June 6, 1990, and the microorganisms were injected 14 days later on June 20. Wellhead injection pressures, volumes, and oil production continue to be monitored. Production data through February 1993, indicated an improvement in oil production of 17.4%.

A presentation detailing the results of this field test was prepared for the New Technology for Independent Producers seminar to be held in Denver, CO, May 6-7, 1993.

Manpower and Financial Status

Manpower and financial expenditures are on schedule.

Status of Project Milestones

Milestone 1 is on schedule.

SGP37

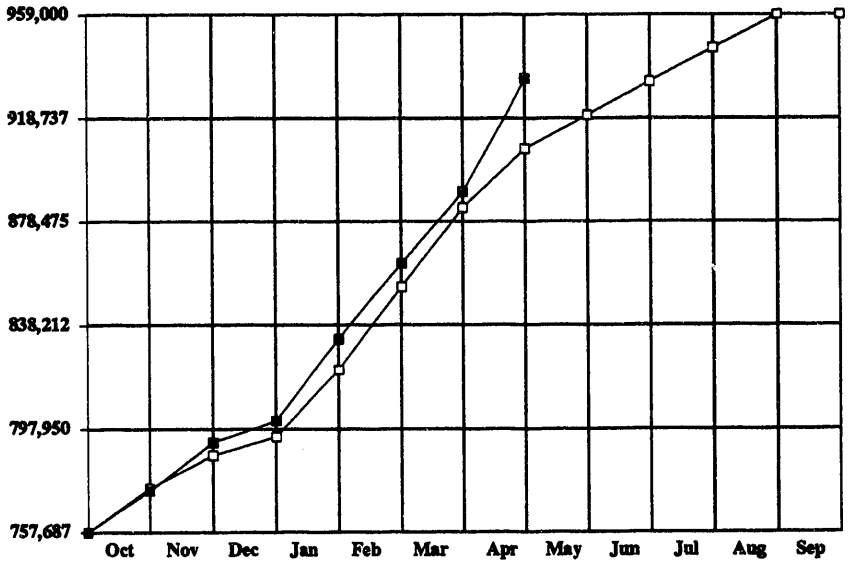
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		1,099,440
Less Subcontracts:	131,463	
Appropriation Balance:	967,977	
Expenditures for the Month:		43,617
Total Expenditures to Date:		1,057,585
Net Available:		41,855
Subcontract Expenses:		,711

Annual Plan Project SGP37

Feasibility Study of Heavy Oil Recovery in the Midcontinent Region: Oklahoma, Kansas, & Missouri

Financial Status

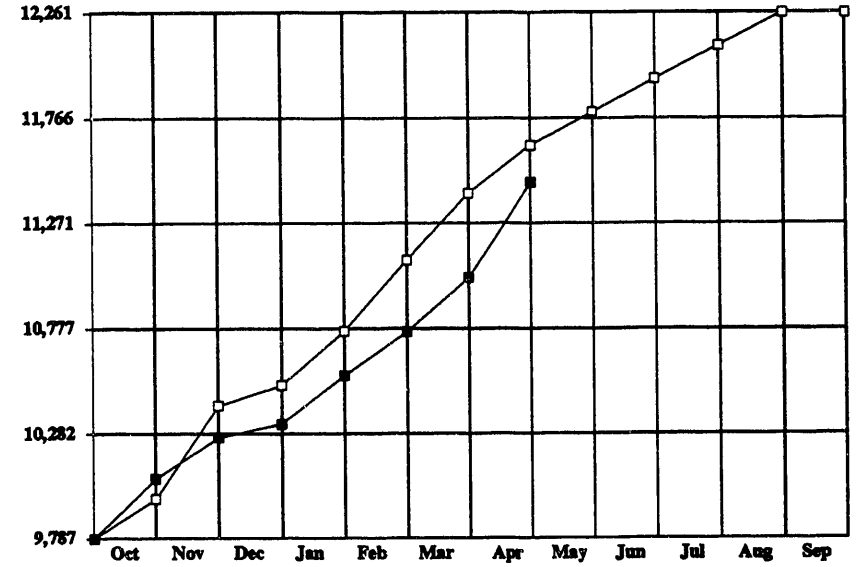


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	775	788	795	821	853	884	907	920	933	946	959	959
Actual	774	793	801	833	862	890	934					
Variance	1	-5	-6	-12	-9	-6	-27	920	933	946	959	959

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		12,655
Man-hours used this Month:	447	
Total Man-hours used to Date:		11,462
Net Available:		1,193

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	9975	10413	10510	10763	11100	11413	11641	11796	11951	12106	12261	12261
Actual	10069	10261	10328	10554	10760	11015	11462					
Variance	-94	152	182	209	340	398	179	11796	11951	12106	12261	12261

Legend for Key Milestones

X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C"= Completed Ahead of Schedule

Key Milestone Status

1 Status Report Describing Results of Computer Modeling Study on Potential for Heavy Oil Recovery — XXX _____ XXX XXX XX_ C

2 Complete Detailed Review of Heavy Oil Potential For Gulf Coast Region — XXX XXX XXX XXX XXX XXX XXX _____ C

3 Status Report Discussing Results of U. S. Heavy Oil Reservoir Data Study — XXX _____ C

SGP37. FEASIBILITY STUDY OF HEAVY OIL RECOVERY IN THE MIDCONTINENT REGION: OKLAHOMA, KANSAS, AND MISSOURI

Accomplishments

The objectives of this research project are (1) to determine the known heavy oil resources of the United States, (2) to evaluate the various economic constraints that may impact development of this resource, and (3) to determine if steam or other EOR processes are applicable to economic production of this resource.

Milestone 1—The computer modeling was completed in March and the results were delivered to the BPO Technical Project Officer. Due to other DOE priority projects, a status report containing results will be delayed until June, and a memo requesting an extended completion date has been submitted to BPO.

Milestone 2—The analysis and update of reservoir data for Texas heavy oil reservoirs was completed this month, and the information is being reviewed for inconsistencies and errors. After the information is reviewed, it will be incorporated into the U.S. heavy oil data base file. Oil production data in the heavy oil data base were updated for several states. Inconsistencies with data from various sources (TORIS public data base, Oil & Gas Journal EOR report, state publications) and parameter ranges were entered into a separate data base for future clarification.

Manpower and Financial Status

Manpower and financial expenditures are on schedule.

Status of Project Milestones

As noted above, milestone 1 is running behind schedule and an extended completion date is being requested. Report NIPER-560, "Feasibility of Heavy Oil Recovery in the Midcontinent Region (Kansas, Missouri, Oklahoma)" is ready for final typing. Report NIPER-606, "Estimates of Future Regional Heavy Oil Production at Three Production Rates—Background Information for Assessing Effects on the U.S. Refining Industry," has been delivered to the BPO.

A report updating the trends in heavy oil production and refining in California was presented at the American Chemical Society Symposium on Enhanced Oil Recovery, Denver, CO, Mar. 28-Apr. 2. The reported data will be published in the symposium Proceedings.

SGP41

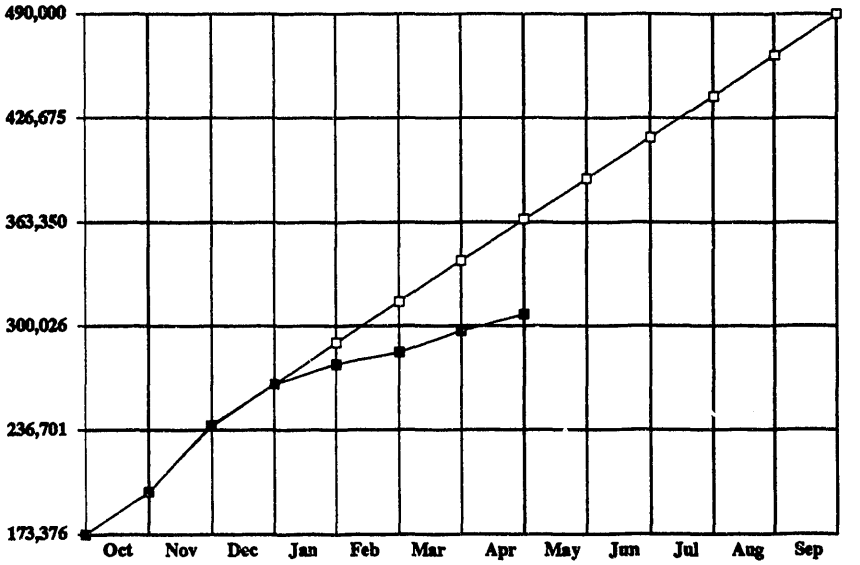
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		618,000
Less Subcontracts:	111,000	
Appropriation Balance:	507,000	
Expenditures for the Month:		10,743
Total Expenditures to Date:		307,413
Net Available:		310,587
Subcontract Expenses:		45,946

Annual Plan Project SGP41

Surfactant-Enhanced Alkaline Flooding Field Project

Financial Status

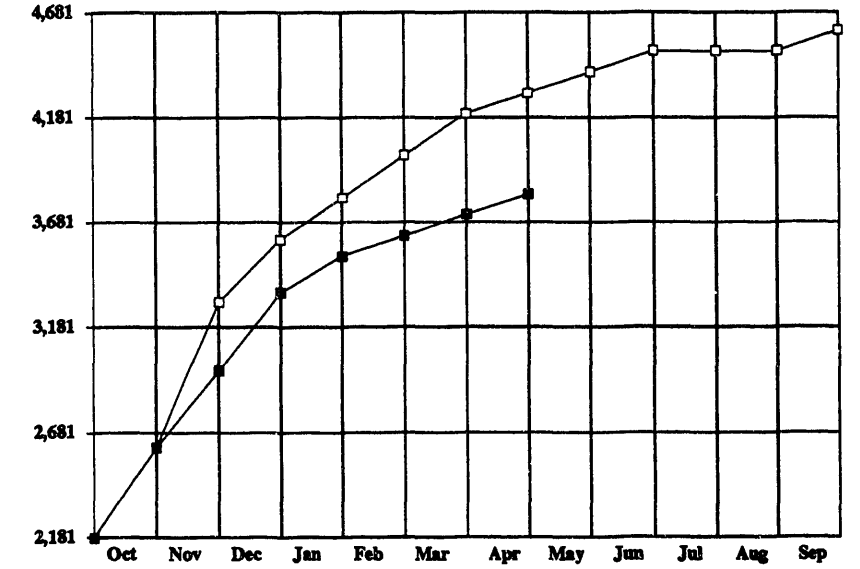


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	199	240	265	290	315	340	365	390	415	440	465	490
Actual	199	239	265	277	284	297	307					
Variance	0	1	0	13	31	43	58	390	415	440	465	490

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		6,000
Man-hours used this Month:	98	
Total Man-hours used to Date:		3,818
Net Available:		2,182

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	2610	3300	3600	3800	4000	4200	4300	4400	4500	4500	4500	4600
Actual	2610	2972	3346	3520	3616	3720	3818					
Variance	0	328	254	280	384	480	482	4400	4500	4500	4500	4600

Legend for Key Milestones

X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Complete Environmental Assessment	XXX XXC
2 Finalize Geological Evaluation of Field Core	XXX XXX XXX XXX XXX X___ C
3 Test Chemical System in Field Core; Finalize Design of Chemical System Based on Results Obtained with Field Core	_____XXX XXX XXX X____C
4 Prepare Presentation on Comparison of Methods for Evaluating Core from a Midcontinent Fluvial-Dominated Deltaic Sandstone Reservoir	_____XXX XXX XXX XXC
5 Inject Chemicals	_____C
6 Complete Oil Recovery Monitoring Phase; Submit Final Report (FY95 Completion Date)	_____

SGP41. SURFACTANT-ENHANCED ALKALINE FLOODING FIELD PROJECT

Accomplishments

The objectives of this pilot project are (1) to obtain information and data that will help demonstrate the applicability of surfactant-enhanced alkaline flooding as a cost-effective EOR method, (2) to transfer the surfactant-enhanced alkaline flooding technology that has been developed under the sponsorship of the DOE to the petroleum industry, and (3) to obtain information regarding procedures for designing and applying this technology that will assist independent producers in sustaining production from mature producing oil fields rather than abandoning marginal wells.

The site selected for the surfactant-enhanced alkaline flooding pilot test is Hepler oil field, which is located in Crawford and Bourbon Counties of the State of Kansas. This near-term application of a promising EOR technology in a fluvial-dominated deltaic type reservoir is consistent with the strategy outlined in DOE's oil research program implementation plan.

Milestone 2—The primary need before implementing the project in the field is a better estimate of the final oil saturation in the area swept by chemical flooding. Final oil saturation has been difficult to estimate from coreflooding experiments due to channeling of fluids through high-permeability streaks in the field cores. In an attempt to better estimate oil saturation in the zone swept by chemicals, corefloods are being performed while monitoring flow patterns via CT scanning. These experiments are being performed under project BE4B, which is supporting this pilot project.

Milestone 3—One remaining task in the final design of the chemical flooding system is to ensure that the sodium bicarbonate originating in western Colorado or Wyoming (North American Chemical Co.) is compatible with the other EOR chemicals. The sample was received this month from North American.

Manpower and Financial Status

Manpower and financial expenditures are behind schedule due to delays that have resulted from unfavorable laboratory testing of cores taken from the area of the field originally selected for the pilot site.

Status of Project Milestones

Because of unfavorable laboratory core test results, project milestones are running behind schedule. During the month of May, a revised set of milestones will be submitted to the BPO for approval.

SGP49

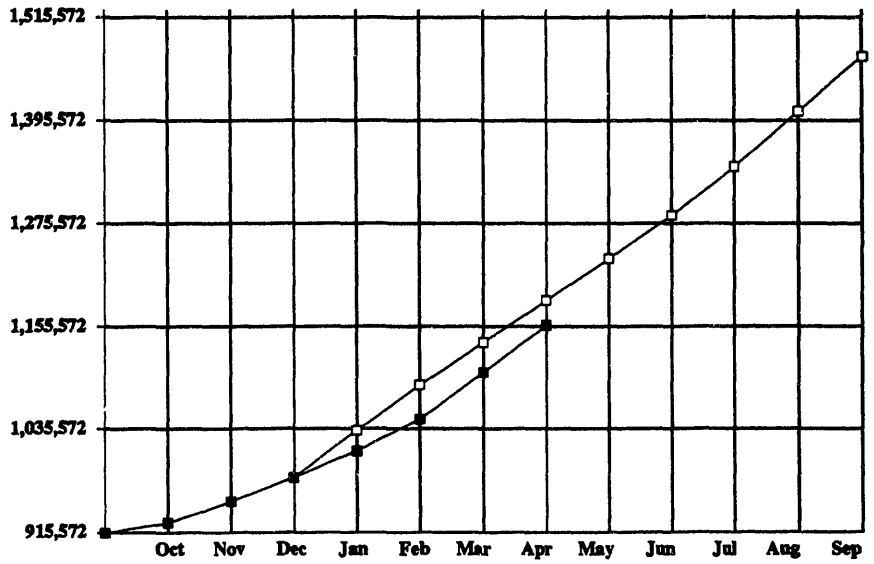
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		1,523,572
Less Cap Equip & Subs:	90,115	
Appropriation Balance:	1,433,457	
Expenditures for the Month:		55,174
Total Expenditures to Date:		1,157,424
Net Available:		366,148
Cap Equip/Subcontract Exp & Commits:		90,115

Annual Plan Project SGP49

Process-Engineering Property Measurements on Heavy Petroleum Components

Financial Status

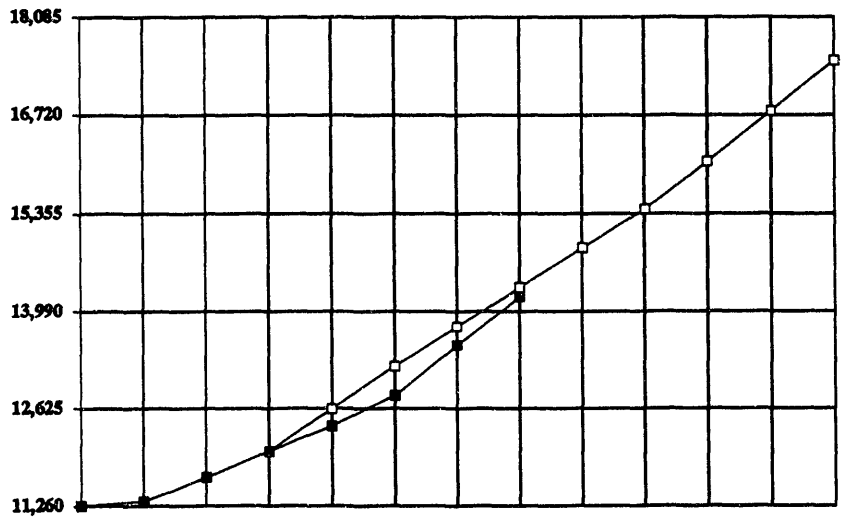


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	927	952	980	1034	1087	1137	1186	1235	1285	1343	1406	1469
Actual	927	952	980	1010	1047	1102	1157					
Variance	0	0	0	24	40	35	29	1235	1285	1343	1406	1469

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		18,085
Man-hours used this Month:	674	
Total Man-hours used to Date:		14,191
Net Available:		3,894

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	11327	11656	12023	12623	13223	13773	14323	14873	15423	16073	16773	17473
Actual	11327	11656	12023	12376	12811	13517	14191					
Variance	0	0	0	247	412	256	132	14873	15423	16073	16773	17473

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Topical Report/Journal Article on the Thermochemical & Thermophysical Properties at High Temperature (Approaching the Critical Region) of Phenanthrene & the Products of Its Hydrogenation — XXX XXX XXX X___ C

2 Prepare a Minimum of Three Journal Articles on the Thermodynamic Properties of Aromatic & Hydroaromatic Compounds Measured in This Research — XXX _____ XXX XXX XXX XXX _____ C

3 Status Report on the Synthesis & Purification of Key Compounds (FY94 Completion Date) _____

4 Status Report Summarizing Data Acquired, Its Utility, & Updated Assessment of Needs for Future Work (FY94 Completion Date) _____

SGP49. PROCESS-ENGINEERING PROPERTY MEASUREMENTS ON HEAVY PETROLEUM COMPONENTS

Accomplishments

Heat capacity and enthalpy studies by adiabatic calorimetry on 1,2-dihydronaphthalene were continued this month. Replicate determinations of the enthalpy of fusion were completed and solid-state studies were begun. Two phase transitions were located in the solid phase. Determination of transition enthalpies has begun.

A topical report, entitled "The Thermodynamic Properties to 700 K of Naphthalene and 2,7-Dimethylnaphthalene," NIPER-678, has been submitted to the BPO. The report fulfills the requirements of FY92 milestone 5. A journal article describing this work was submitted to the *Journal of Chemical Thermodynamics*. Work on a topical report on phenanthrene and its hydrogenation products continues (milestone 1).

A commercial zone-refining apparatus was received and assembled. Testing and determination of operating parameters has begun. A sample of 1,2,3,4-tetrahydrofluoranthene, synthesized at Oklahoma State University, will be zone refined once the apparatus is operational.

The topical report in which the thermodynamics of hydrogen shuttling are compared for pyrene, phenanthrene, and anthracene, is near completion. This report was not part of the original milestones for this project, but will be completed due to the important insights it provides to the controversy existing in the literature over the mechanism(s) of hydrogen shuttling. Work on the organometallics report (FY92 milestone 3) is also near completion.

Enthalpy of combustion studies on 1,2-dihydronaphthalene and 1,10-trimethylenephenanthrene continued. These compounds are included in a series of measurements scheduled for completion in this quarter.

The status reports for research completed in FY92 (FY92 milestones 7 and 8) are near completion.

Manpower and Financial Status

Manpower and financial expenditures are on schedule.

Status of Project Milestones

Details of project milestones are given above.

SGP50

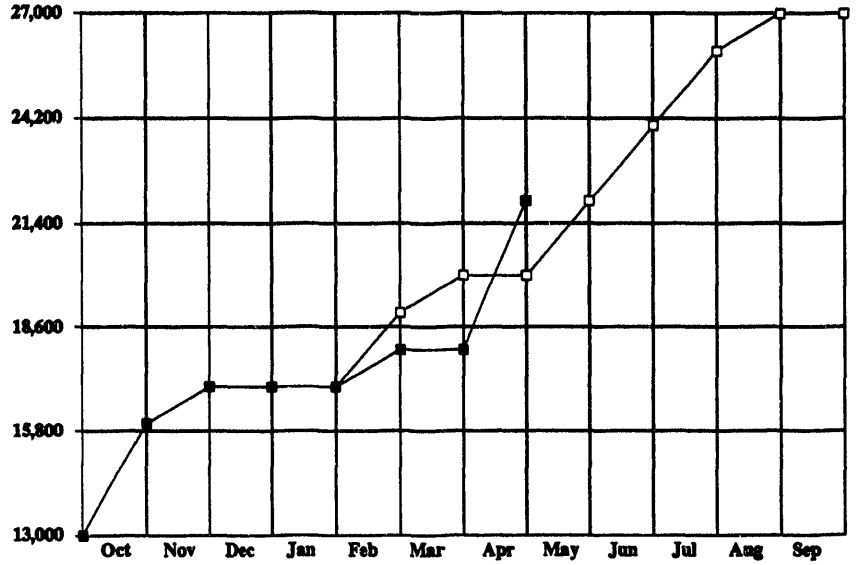
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		296,000
Less Subcontracts:	269,000	
Appropriation Balance:	27,000	
Expenditures for the Month:		3,730
Total Expenditures to Date:		197,319
Net Available:		98,681
Subcontract Expenses:		178,237

Annual Plan Project SGP50

Training In Development & Application of Petroleum Production Technologies

Financial Status

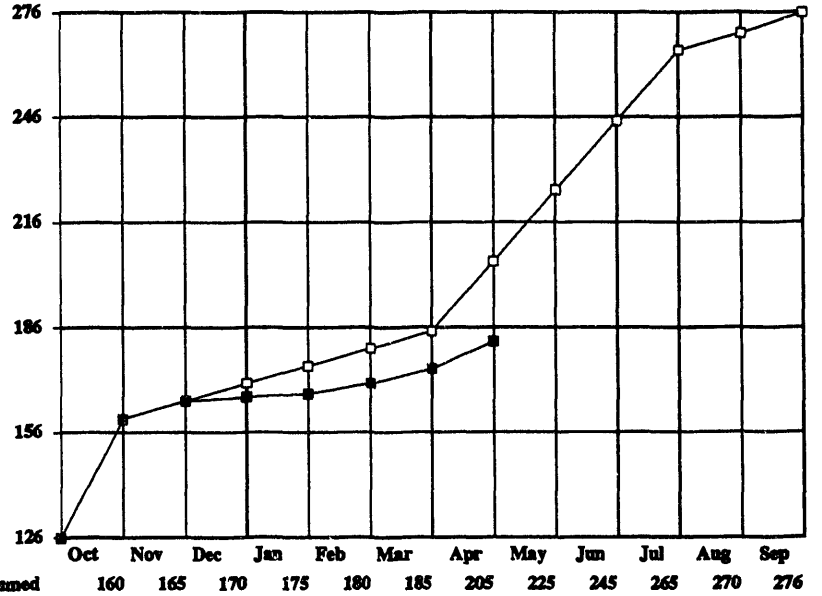


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	16	17	17	17	19	20	20	22	24	26	27	27
Actual	16	17	17	17	18	18	22					
Variance	0	0	0	0	1	2	-2	22	24	26	27	27

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		276
Man-hours used this Month:	8	
Total Man-hours used to Date:		182
Net Available:		94

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	160	165	170	175	180	185	205	225	245	265	270	276
Actual	160	165	166	167	170	174	182					
Variance	0	0	4	8	10	11	23	225	245	265	270	276

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Submit Final Report on Development & Application of Petroleum Production Technologies
2 Recruit Summer Interns
3 Interview and Select Summer Interns
4 Supervise and Teach Summer Interns
5 Complete Final Report

XXC
XXX XXX XXX XXX XXX XXC
XXX XXX ____C
C
C

SGP50. DEVELOPMENT AND APPLICATION OF PETROLEUM PRODUCTION TECHNOLOGIES

Milestones 2 and 3—Nineteen offers to students were made, and all have accepted. A letter was sent to these students informing them of the seminars and meetings planned for this summer which will include one safety training session and eight seminars. The topics of these seminars include geology, primary and secondary recoveries, EOR, biotechnology, and environmental issues associated with petroleum production. George Hirasaki, a professor from Rice University, will give a seminar on wettability. The teacher-interns from NIPER and Phillips are also planning to attend these seminars.

Manpower and Financial Status

Financial expenditures are on schedule, but manpower is slightly below projection due to extended period (approximately 1 month) in finalizing intern recruitment.

Status of Project Milestones

The work planned for milestone 2 has been completed. The other project milestones are on schedule.

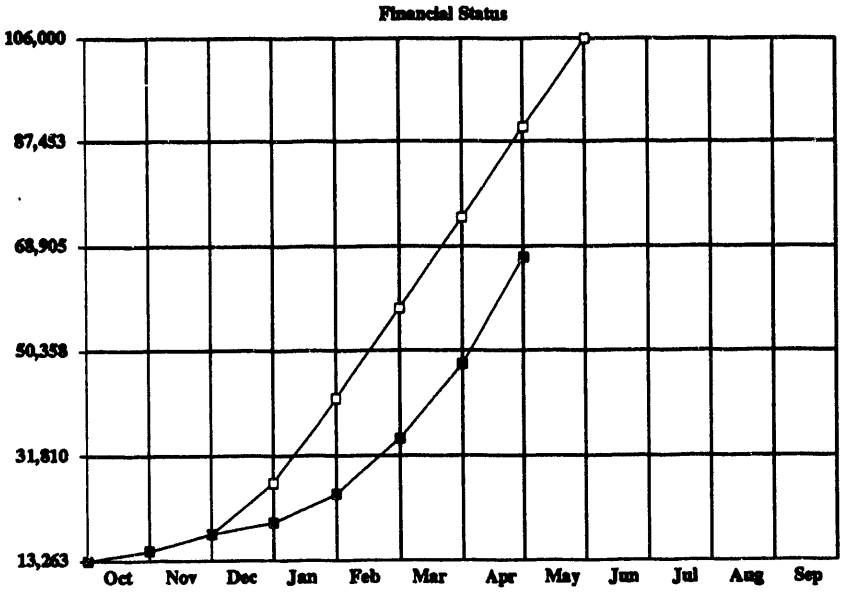
SGP56

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		106,000
Less Subcontracts:	0	
Appropriation Balance:	106,000	
Expenditures for the Month:		19,423
Total Expenditures to Date:		66,986
Net Available:		39,014
Subcontract Expenses:		0

Annual Plan Project SGP56

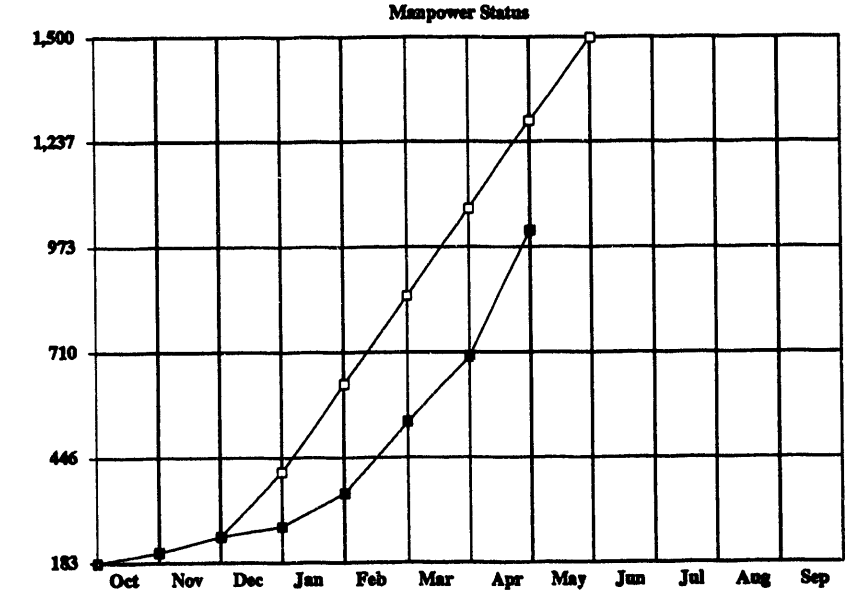
Upgrade BPO Crude Oil Analysis Data Base



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	15	18	27	42	58	74	90	106				
Actual	15	18	20	25	35	48	67					
Variance	0	0	7	17	23	26	23	106	0	0	0	0

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		1,500
Man-hours used this Month:	315	
Total Man-hours used to Date:		1,014
Net Available:		486



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	208	247	410	630	850	1070	1290	1500				
Actual	208	247	272	356	535	699	1014					
Variance	0	0	138	274	315	371	276	1500	0	0	0	0

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C"= Completed Ahead of Schedule

Key Milestone Status

1 Participate in UNITAR Crude Oil Analysis Round Robin									C
2 Complete Development of Crude Oil Analysis (COA) Data Management System									C
3 Upgrade Data in Data Base	XXX	XXX	XXX	XXX	XXX	XXX			C
4 Prepare a New COA Data Base User's Guide	XXX	XXX	XXX	XXX	XXX	XXX	XXX		C

SGP56. UPGRADE BPO CRUDE OIL ANALYSIS DATA BASE

Accomplishments

The objectives of this project are (1) to develop and maintain a high-integrity, on-line, crude oil analysis (COA) data base that is available to the public; (2) to upgrade and update crude oil analyses for inclusion in this data base; and (3) to participate in the UNITAR analysis round robin.

Milestone 1—A preliminary report, "Third Round Robin on Heavy Crudes and Bitumen Statistical Analysis on Cerro Negro Crude Analytical Data," was distributed by the United Nations Institute for Training and Research Centre for Heavy Crudes and Tar Sands to project participants for review. A final date for the conference has not been established.

Milestone 2—Computer coding for the on-line data base is progressing. A commercial bulletin board software (BBS) will control the communication between the user and the on-line computer, and commercial data management software will control the file storage and retrieval functions. A written computer code will control the user interface, develop queries, and return results to the user. This month, the user interface was tested using direct screen writes with the BBS. Additional work was done on keyword queries by the user.

Milestone 3—Crude oil samples will be analyzed for trace metals and for hydrocarbon type. No analytical work was performed this month due to other priority work and required repairs to the ICP spectrophotometer. Hard copy files of crude oil analyses were moved. Analyses that are not in the data base are being identified.

Manpower and Financial Status

Additional funding has been allocated to this project. A revised milestone schedule and budget will be submitted for approval next month.

Status of Project Milestones

Project milestones are on schedule.

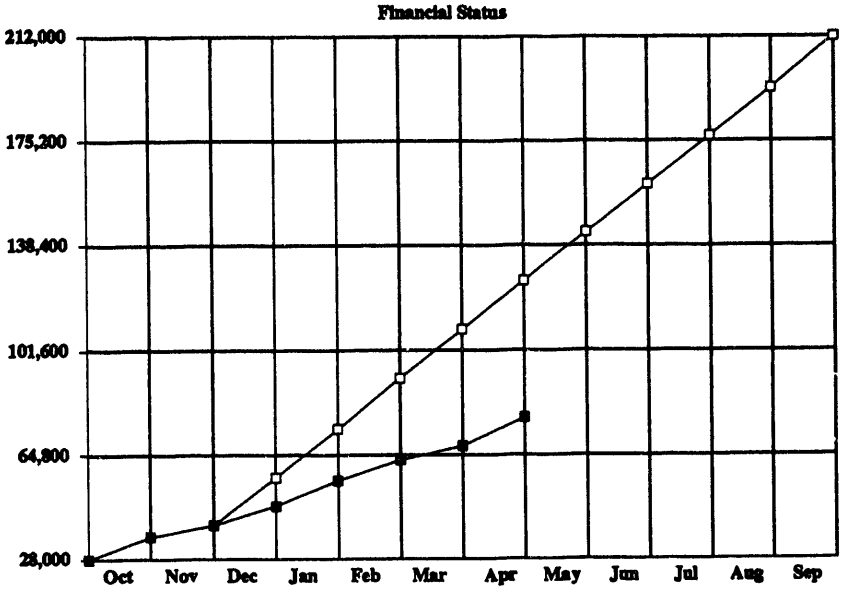
SGP58

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		350,000
Less Subcontracts:	0	
Appropriation Balance:	350,000	
Expenditures for the Month:		9,769
Total Expenditures to Date:		77,724
Net Available:		272,276
Subcontract Expenses:		0

Annual Plan Project SGP58

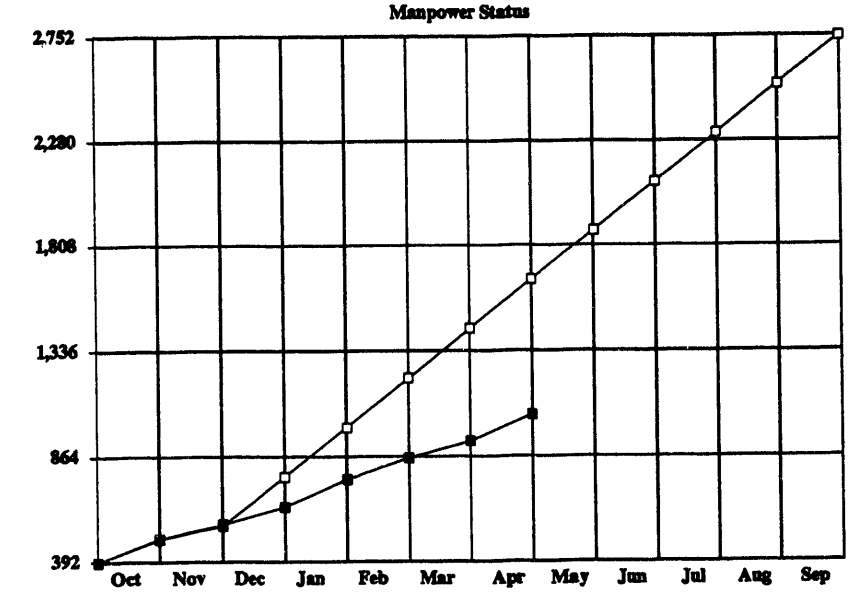
Simulation Analysis of Steam-Foam Projects



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	36	40	57	74	92	109	126	143	160	177	194	212
Actual	36	40	47	56	63	68	78					
Variance	0	0	10	18	29	41	48	143	160	177	194	212

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		4,410
Man-hours used this Month:	121	
Total Man-hours used to Date:		1,052
Net Available:		3,358



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	494	555	775	995	1214	1434	1654	1873	2093	2313	2532	2752
Actual	498	562	642	762	860	931	1052					
Variance	-4	-7	133	233	354	503	602	1873	2093	2313	2532	2752

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Complete Review of Data from Previous Steamflood Projects
2 Complete Basic History Match
3 Finalize Full-Pattern Simulation Study (FY94 Completion Date)
4 Final Report on Research Findings (FY94 Completion Date)

XXX XXC
XXX XXX XXX XXX XXX XXX XXX _____C

SGP58. SIMULATION ANALYSIS OF STEAM-FOAM PROJECTS

Accomplishments

The objectives of this research project are (1) to study the viability of the steam-foam process by analyzing data from selected completed steam-foam projects and (2) to assess conditions under which the process is likely to succeed, both technically and economically.

Milestone 2—The history match of Chevron's Section 26-C Steam-Foam Pilot is continuing. As pointed out in the March 1993 Monthly Report, it is difficult to match both the temperature and pressure simultaneously due to the assumption that foam propagates at the same rate as surfactant. In real reservoirs, a foam front lags behind the surfactant front. This month, attempts were made to match both temperature and pressure by retarding the foam propagation rate. The advancement of the foam front can be slowed (1) by increased surfactant adsorption, (2) by increased residual gas saturation, or (3) by both increased surfactant adsorption and residual gas saturation. Only by increasing the surfactant adsorption and residual gas saturation was it possible to improve the simulator's matching ability. Additional simulation runs are planned with further adjustment of surfactant adsorption rate and residual gas saturation values to improve the predictability.

Manpower and Financial Status

Manpower and financial expenditures are below planned estimates due to senior staff commitments to other DOE priority projects.

Status of Project Milestones

Project milestones are on schedule.

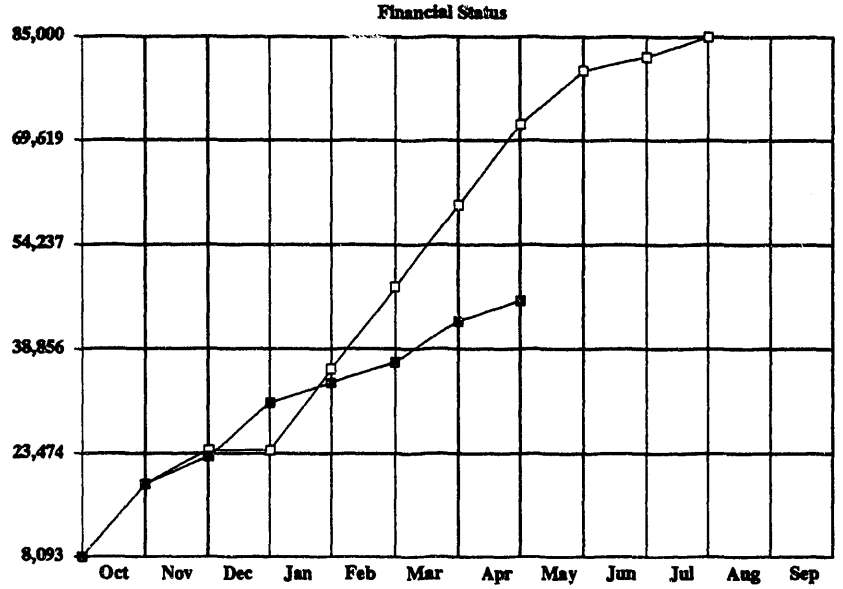
SGP61

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		110,000
Less Subcontracts:	24,900	
Appropriation Balance:	85,100	
Expenditures for the Month:		2,817
Total Expenditures to Date:		46,063
Net Available:		63,937
Subcontract Expenses:		18,005

Annual Plan Project SGP61

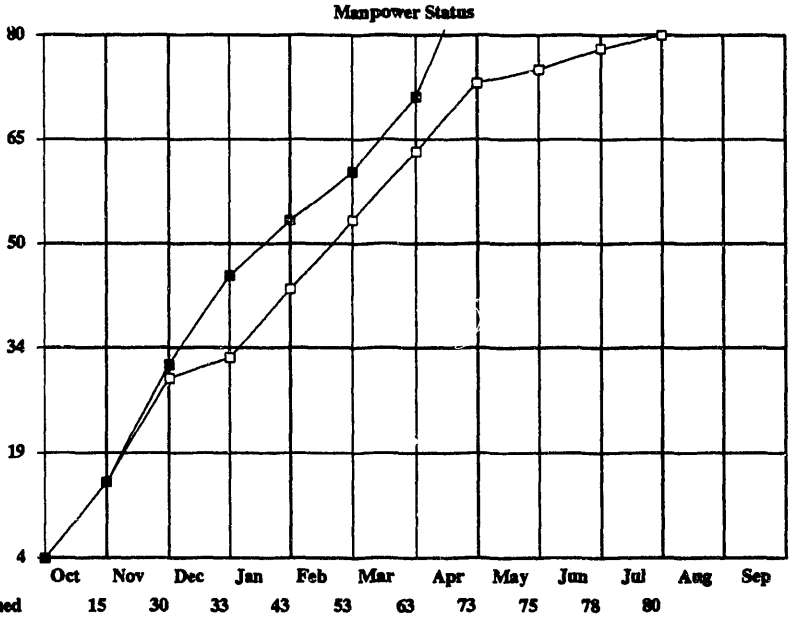
DOE Educational Initiative Project



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	19	24	24	36	48	60	72	80	82	85		
Actual	19	23	31	34	37	43	46					
Variance	0	1	-7	2	11	17	26	80	82	85	0	0

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		80
Man-hours used this Month:	20	
Total Man-hours used to Date:		91
Net Available:		(11)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	15	30	33	43	53	63	73	75	78	80		
Actual	15	32	45	53	60	71	91					
Variance	0	-2	-12	-10	-7	-8	-18	75	78	80	0	0

Legend for Key Milestones

X = Work Completed

C = Planned Completion Date

C'= Revised Completion Date

C"= Completed Ahead of Schedule

Key Milestone Status

1 Complete Assessment of School Needs & Community Resources	XXX XXC
2 Complete Development of Science Classroom Support Bureau	XXX XXX XXX XXX XXX _____ XXX _____ C
3 Coordinate Staff Development Opportunities for Teachers	_____ XXX XXX XXX XXX XXX _____ C

SGP61. DOE EDUCATION INITIATIVE PROJECT

Accomplishments

The objective of the DOE Education Initiative Project is to enrich the science programs of public schools in the northeastern part of Oklahoma by developing partnerships between the schools, communities, businesses, and other interested groups.

Milestone 2—In coordinating the DOE Regional Science Bowl for Oklahoma, responses to the evaluation forms were tabulated and sent to the Science Bowl Committee, and Science Bowl Officials. Judy Kokesh accompanied the Edmond Memorial High School team and coach to the National Science Bowl competition in Washington, D.C., Apr. 16-19. She also served as point of contact at the National Science Bowl for the Oklahoma team.

Milestone 3—Ms. Kokesh met with Duane Wilson of Conoco, Inc., to discuss the Oil and Gas Exploration curriculum and to seek support for the "Train the Trainers" workshop in Tulsa. A follow-up letter was sent to Mr. Wilson.

A brochure explaining the Oil and Gas Exploration Module workshop in Oklahoma City, summer 1993, was developed and mailed to:

All high school principals in the state
Oklahoma Science Teachers' Association members
Science coordinators and earth science teachers in Oklahoma County

Mike Bernard, president of the Midcontinent Oil and Gas Association, was provided information pertaining to the Oil and Gas Exploration curriculum. He was very interested and suggested that a presentation be made at the next meeting of the organization. Likewise, Mickey Thompson, executive vice-president of the Oklahoma Independent Petroleum Association, was contacted and was also quite interested in the curriculum. A presentation was made to their Board of Directors in Norman, April 30. The OIPA is interested in supporting education projects but currently does not have the necessary 501c3 status. However, this is in process of being worked out, and the organization may be in position to provide funding for the teacher kits at future workshops. NIPER has been invited to make a presentation at the OIPA Annual Convention, in mid-June.

For the Teacher Internship Program, application information for the joint Phillips-NIPER teacher internship project was mailed to 60 teachers in Bartlesville and surrounding districts. Teacher applications will be reviewed by supervising researchers in early May.

Manpower and Financial Status

Financial expenditures are low, while manpower is higher than originally scheduled. This is due to the inability to plan accurately for the type of activities involved.

Status of Project Milestones

Milestones 2 and 3 are on schedule.

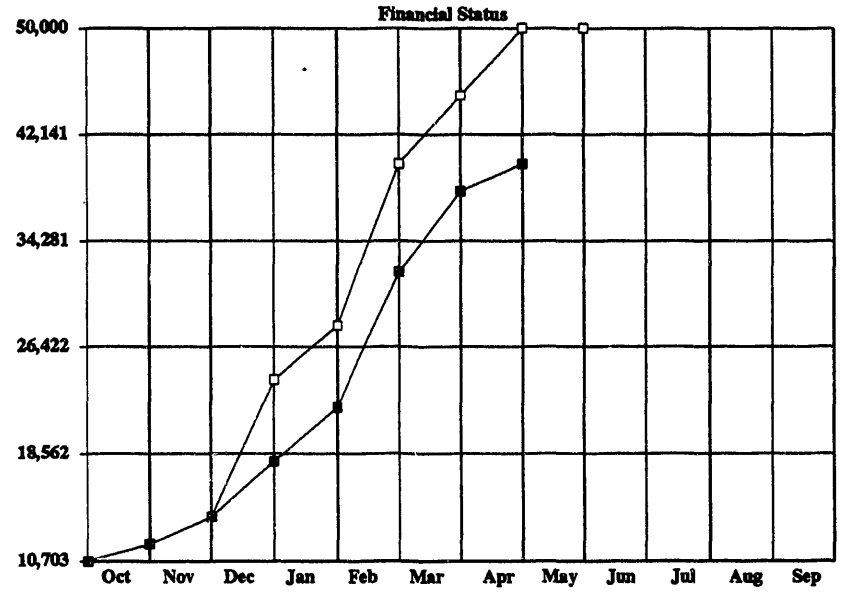
SGP63

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		50,000
Less Subcontracts:	0	
Appropriation Balance:	50,000	
Expenditures for the Month:		2,720
Total Expenditures to Date:		40,489
Net Available:		9,511
Subcontract Expenses:		0

Annual Plan Project SGP63

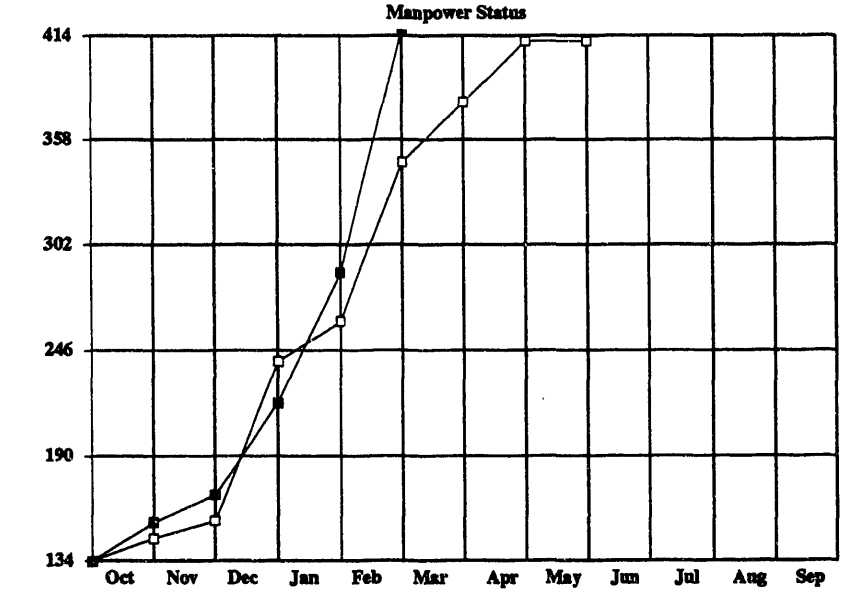
Field Application of Foams for Oil Production Symposium



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	12	14	24	28	40	45	50	50				
Actual	12	14	18	22	32	38	40					
Variance	0	0	6	6	8	7	10	50	0	0	0	0

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		475
Man-hours used this Month:	44	
Total Man-hours used to Date:		511
Net Available:		(36)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	146	155	240	261	346	378	411	411				
Actual	154	169	218	287	417	467	511					
Variance	-8	-14	22	-26	-71	-89	-100	411	0	0	0	0

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C"= Completed Ahead of Schedule

Key Milestone Status

1 Organize & Conduct a Symposium on Field Application of Foams	XXX XXX XXX XXX XXC
2 Compile Summary of Technical Comments Obtained During Symposium	_____ XXX XXC
3 Compile Proceedings for DOE Fossil Energy Report	_____ XXX XXX XXX ____C

SGP63. FIELD APPLICATION OF FOAMS FOR OIL PRODUCTION SYMPOSIUM

Accomplishments

The DOE and NIPER cosponsored a day and a half symposium on the field application of foams for oil production at the Red Lion Inn, Bakersfield, CA, Feb. 11-12, 1993. Seventy-two individuals from seven countries were in attendance and actively participated in the discussions and panel presentations on the current status of foam technology. The agenda included 13 technical papers and 8 poster sessions. Responses from the participants indicated that the symposium was an overwhelming success, and many wanted to see additional process-specific meetings of this type.

Milestoner 3—The symposium Proceedings have been submitted to the reviewers for comment, and it is anticipated the report (NIPER-669) will be ready for submittal to the BPO early next month. The Proceedings will be distributed to the attendees and the public following publication as a DOE/FE report.

A status report (NIPER-681) on the future of foams and problems associated with the application of foams has been prepared at the request of BPO. The report is in review.

Manpower and Financial Status

Manpower usage is above projections due to the extra time involved in preparing a summary on the benefits of the foam symposium. Financial expenditures are low because some invoices associated with the symposium are still outstanding.

Status of Project Milestones

Milestone 3 is on schedule. Following the symposium, more than 20 requests were received for copies of the Preprints; however, all available copies had previously been distributed. A listing of these unfulfilled requests will be provided to the BPO for distribution as Proceedings when they are printed as a DOE/FE report.

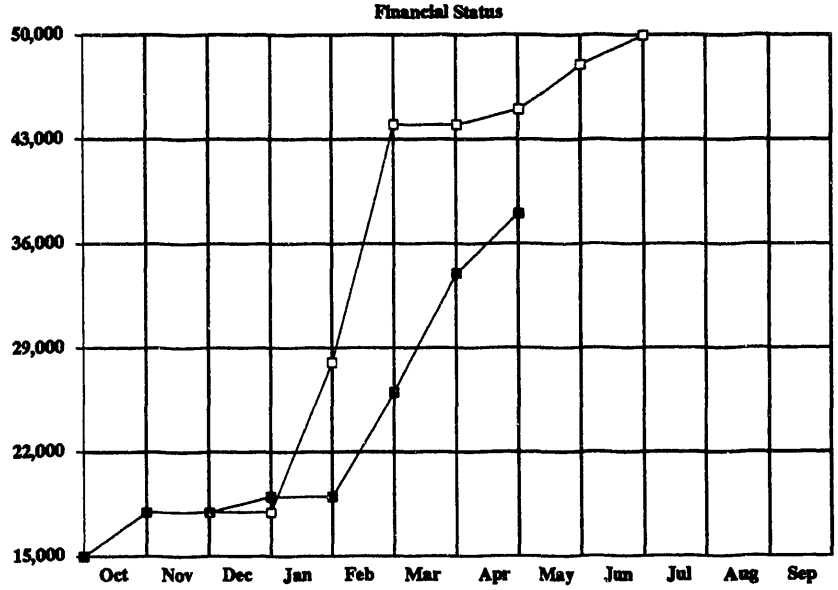
SGP64

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		174,350
Less Subcontracts:	124,350	
Appropriation Balance:	50,000	
Expenditures for the Month:		3,353
Total Expenditures to Date:		37,539
Net Available:		136,811
Subcontract Expenses:		0

Annual Plan Project SGP64

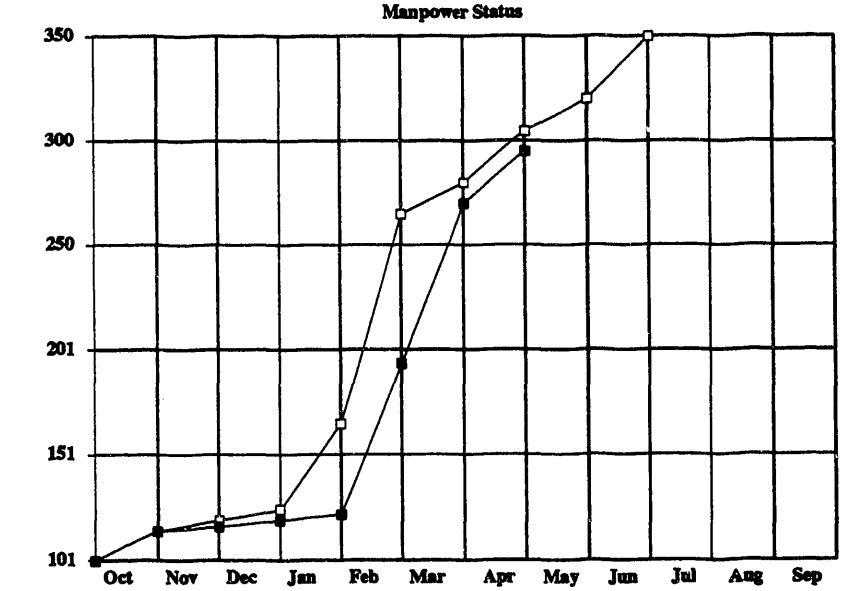
Technology Transfer to Independent Producers



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	18	18	18	28	44	44	45	48	50			
Actual	18	18	19	19	26	34	38					
Variance	0	0	-1	9	18	10	7	48	50	0	0	0

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		350
Man-hours used this Month:	25	
Total Man-hours used to Date:		295
Net Available:		55



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	115	120	125	165	265	280	305	320	350			
Actual	115	117	120	123	194	270	295					
Variance	0	3	5	42	71	10	10	320	350	0	0	0

Legend for Key Milestones

X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C"= Completed Ahead of Schedule

Key Milestone Status

1 Review Response to First Seminar; Complete Design for Additional Seminars — XXX XXC
2 Conduct Series of One-Day Seminars — _____XXX XXX XXC
3 Submit Final Report Describing Project Results — _____XXX XXX _____C

SGP64. TECHNOLOGY TRANSFER TO INDEPENDENT PRODUCERS

Accomplishments

The objective of this project is to transfer information, through a series of seminars, on oil and gas related subjects which have been identified by independent operators as having the highest priority.

Milestone 3—A first draft of the final report analyzing the technology transfer activities in this project has been completed. In addition to the analysis, the report also includes comments by independent producers, survey results, and recommendations for future projects.

Manpower and Financial Status

Manpower usage is on schedule, and financial expenditures are approaching planned estimates.

Status of Project Milestones

Milestone 3 is on schedule.

SGP69

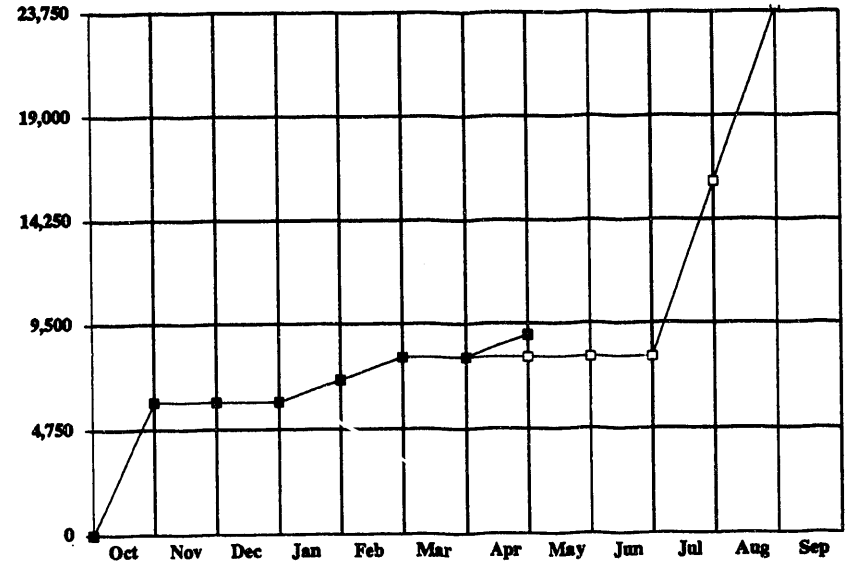
FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		**23,750**
Less Subcontracts:	**0**	
Appropriation Balance:	**23,750**	
Expenditures for the Month:		**100**
Total Expenditures to Date:		**8,501**
Net Available:		**15,249**
Subcontract Expenses:		**0**

Annual Plan Project SGP69

Compilations and Analysis of Outcrop Data from the Muddy and Almond Formations

Financial Status

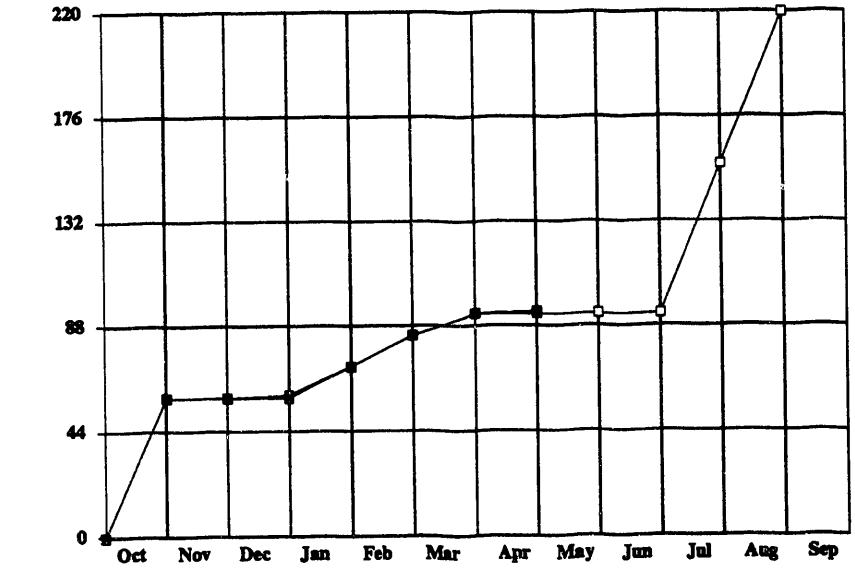


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	6	6	6	7	8	8	8	8	8	16	24	
Actual	6	6	6	7	8	8	9					
Variance	0	0	0	0	0	0	-1	8	8	16	24	0

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		**212**
Man-hours used this Month:	**1**	
Total Man-hours used to Date:		**94**
Net Available:		**118**

Manpower Status



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned	58	58	58	71	84	93	93	93	93	156	220	
Actual	58	58	59	71	84	93	94					
Variance	0	0	-1	0	0	0	-1	93	93	156	220	0

Legend for Key Milestones

X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Supply Missing Data, Interpretations, & Analyses of Outcrop Data Collected — XXX _____ XXX XXC

2 Correlate Minipermeameter & CT Density Data with Sedimentological Features in Core Well No. 2 — _____ XXX _____ C

3 Compile Almond & Muddy Formation Outcrop Data into Transferable Format & Prepare Illustrations & Documentation of Data Files — _____ C

4 Topical Report Containing a Compilation of Data Collected & Analyzed from Muddy & Almond Formation Outcrops & Providing Descriptions, Sedimentological Interpretations, Correlations, & Analyses of Muddy & Almond Formation Outcrop Sections Studied — _____ C

5 Submit Electronic Files of Permeability & Porosity Data, Grain Size, & Facies Data from Muddy & Almond Formation Outcrops — _____ C

SGP69. COMPILATION AND ANALYSIS OF OUTCROP DATA FROM THE MUDDY AND ALMOND FORMATIONS

Accomplishments

The objectives of this project are (1) to compile outcrop data from the Muddy and Almond formations; (2) supply missing data, interpretations, and analyses where needed; and (3) put data in a transferable format for use by interested parties.

No work was performed on this project this month. Work will resume in June.

Manpower and Financial Status

Financial expenditures and manpower have been rescheduled with permission of the BPO.

Status of Project Milestones

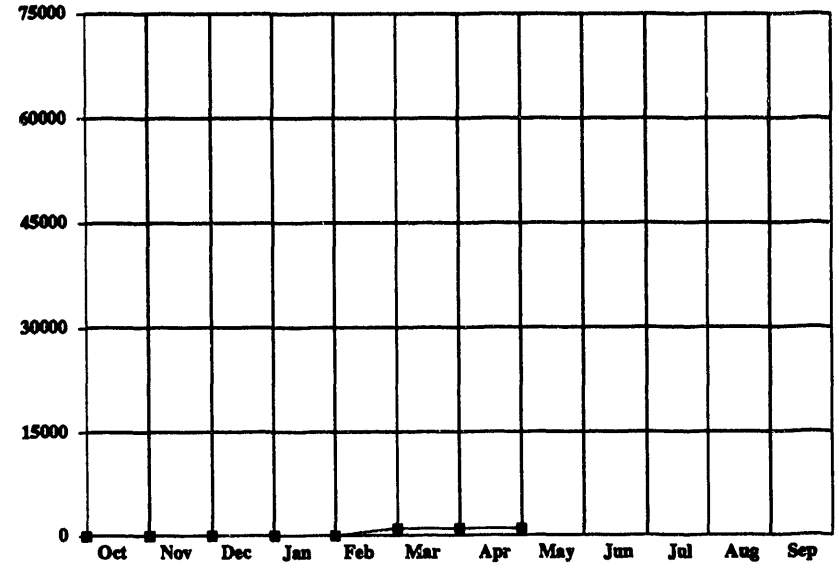
Milestones have been extended to accommodate manpower and financial rescheduling.

SGP72

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		100,000
Less Subcontracts:	25,000	
Appropriation Balance:	75,000	
Expenditures for the Month:		0
Total Expenditures to Date:		589
Net Available:		99,411
Subcontract Expenses:		0

Financial Status



	Mar	Apr	
Planned	1	1	1
Actual	1	1	1
Variance	0	0	0

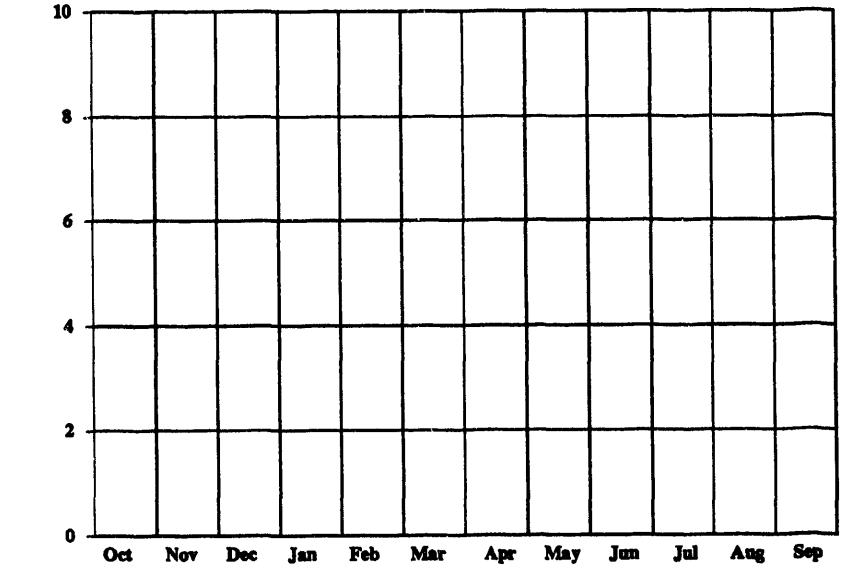
Annual Plan Project SGP72

Implementation of Oil and Gas Technology Transfer Initiative

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		0
Man-hours used this Month:	0	
Total Man-hours used to Date:		0
Net Available:		0

Manpower Status



Planned
Actual
Variance

Legend for Key Milestones

X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Organize Industry Coordinating Committee	XXX XXC
2 Prepare Report on Recommendations for Design and Implementation of a Comprehensive National Technology Transfer Program	XXX ____C

SGP72. IMPLEMENTATION OF OIL AND GAS TECHNOLOGY TRANSFER INITIATIVE

Accomplishments

The objectives of this project are to achieve effective coordination of technology transfer efforts among DOE and the diverse organizations that are part of the petroleum industry and to provide feedback to DOE regarding technology needs of the petroleum industry.

Milestone 1—An organizational meeting was held Jan. 18, 1993 in Austin, TX, to discuss formation of an industry committee to facilitate transfer of oil and gas technology to the domestic petroleum industry. Invitees to the meeting included 26 representatives from various sectors of the petroleum industry, societies, and trade associations and five observers from DOE and national laboratories. Presentations were made by IPAA representatives regarding approaches for implementing a technology transfer program. Representatives from TIPRO, TORP, the Illinois Geological Survey, and the New Mexico Petroleum Recovery Research Center made brief presentations about ongoing technology transfer programs. A majority of those attending selected the name of the coordinating committee to be the Petroleum Technology Transfer Council (PTTC). This completed milestone 1.

Milestone 2—A working group meeting of the PTTC was held in Dallas on Feb. 8-9, 1993, to work on preparation of a report on design and implementation of a comprehensive national technology transfer program for submission to DOE. Debra Rowell, Vice-President of Economics with the IPAA, is serving as the coordinator for preparation of the report. The meeting focused on discussions of the elements of the technology transfer program and the structure of the report to DOE. A draft of the report has been prepared and is currently being reviewed and revised by members of the committee. The committee expects to submit a draft of the report to DOE near the end of the month.

Manpower and Financial Status

No direct labor is being charged on this project. Only direct costs associated with the project are being charged. There is no manpower allocated to the project; and, because of the uncertainty in the timing of expenditures, it is not possible to predict the schedule for financial expenditures. The financial charts reflect only actual expenditures and not any budget projections.

Status of Project Milestones

Milestone 1 has been completed. Milestone 2 is on schedule.

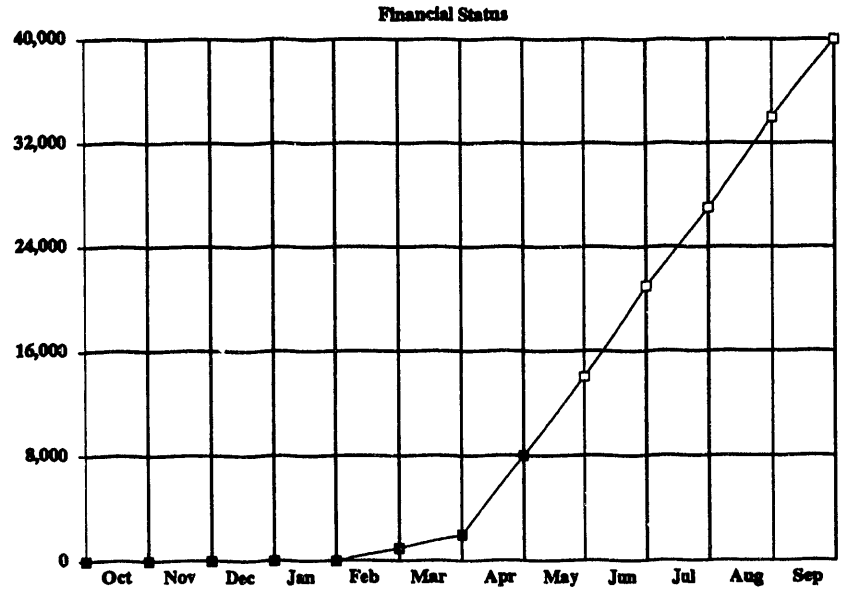
SGP73

FINANCIAL STATUS OF THE PROJECT FOR APRIL

Total Appropriation:		40,000
Less Subcontracts:	0	
Appropriation Balance:	40,000	
Expenditures for the Month:		6,229
Total Expenditures to Date:		7,874
Net Available:		32,126
Subcontract Expenses:		0

Annual Plan Project SGP73

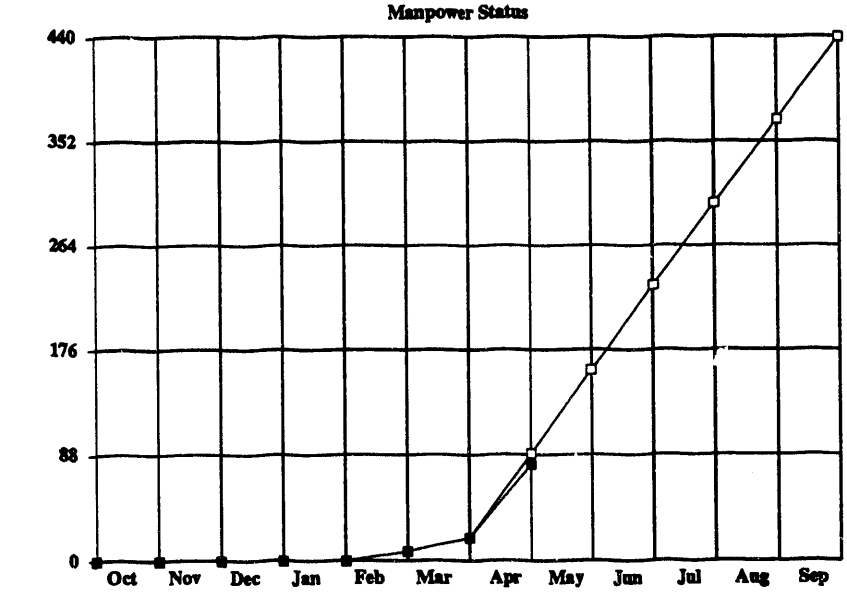
Horizontal Well Production from Fractured Reservoirs



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned						1	2	8	14	21	27	34	40
Actual						1	2	8					
Variance						0	0	0	14	21	27	34	40

MANPOWER STATUS OF THE PROJECT FOR APRIL

Total Man-hours:		440
Man-hours used this Month:	69	
Total Man-hours used to Date:		80
Net Available:		360



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Planned						8	19	89	159	230	300	370	440
Actual						8	19	80					
Variance						0	0	9	159	230	300	370	440

Legend for Key Milestones
X = Work Completed
C = Planned Completion Date
C'= Revised Completion Date
C''= Completed Ahead of Schedule

Key Milestone Status

1 Complete Fracture Data Collection from Reservoir and Outcrop _____ XXX XXC
2 Improve Transfer Function Between Rock Matrix and Fracture _____ XXX XXX ____C
3 Finalize Development of Fracture Reservoir Model _____ C
4 Conduct Numerical Simulation of Horizontal Production from Fractured Reservoirs _____ C
5 Topical Report Describing Horizontal Production from Reservoir _____ C

SGP73. HORIZONTAL WELL PRODUCTION FROM FRACTURED RESERVOIRS

Accomplishments

The objective of this project is to determine effects of natural fractures on horizontal well production using numerical simulation to provide guidelines, screening criteria, or analytical predictions of horizontal well production.

Milestone 1—The collection of fracture density and distribution patterns from reservoirs and outcrops has been completed.

Milestone 2—The shape factor in the transfer function was calculated by solving the three-dimensional diffusivity equation of a rock matrix block under unsteady-state production. The diffusivity equation in the x, y, and z coordinate was solved in two cases by assuming different boundary conditions of (1) constant fracture pressure and (2) constant flow rate. This is the first time that the shape factor was derived under the condition of unsteady-state production in contrast to the condition of pseudo steady state assumed by other studies denoted in the literature.

Shape factor values are high at the initial depletion stage under unsteady-state conditions. When the fracture pressure is constant, the shape factor converges to π^2/d^2, $2\pi^2/d^2$, and $3\pi^2/d^2$ for one-, two-, and three-dimensional rock matrix, respectively, at the dimensionless time (t_D) of about 0.5. The 'd' value in the shape factor formula is the length of rock matrix. The period of 0.5 for t_D ranges from less than 1 day for commonly encountered fractured reservoirs to months for large and tightly fractured rock.

When the flow rate from the rock matrix to the fracture is constant, the fracture pressure varies with location on the rock surface. Based on the average fracture pressure, the shape factor decreases with production time until a t_D value of 0.05 is reached. The shape factor values increase with time when the t_D value is greater than 0.05, and the shape factor values at 0.05 are $10.2/d^2$, $20.4/d^2$, and $30.6/d^2$, for one-, two-, and three-dimensional rock matrix flow, respectively. The shape factors calculated from the case of constant flow rate are less than those from the case of constant fracture pressure when the t_D value is less than 0.1.

The shape factor values calculated from unsteady state production are higher than those proposed by Kazemi (*SPEJ*, Dec. 1976) and by Coats (SPE paper 18427), but less than those by Warren and Roots (*SPEJ*, Sept. 1963).

Manpower and Financial Status

Manpower and financial expenditures are on schedule.

Status of Project Milestones

Milestone 2 has been completed. The other milestones are on schedule.

DATE
FILMED
7/13/93