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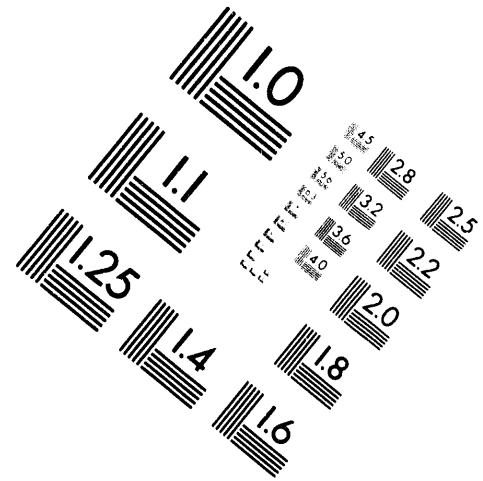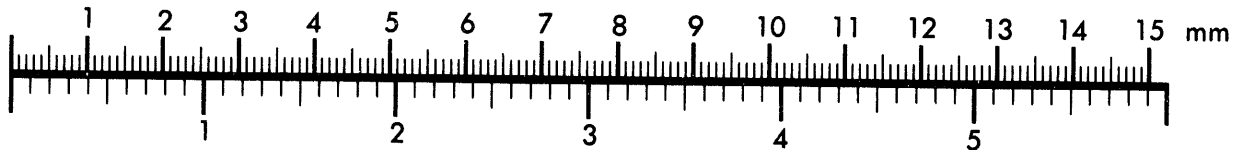**Association for Information and Image Management**
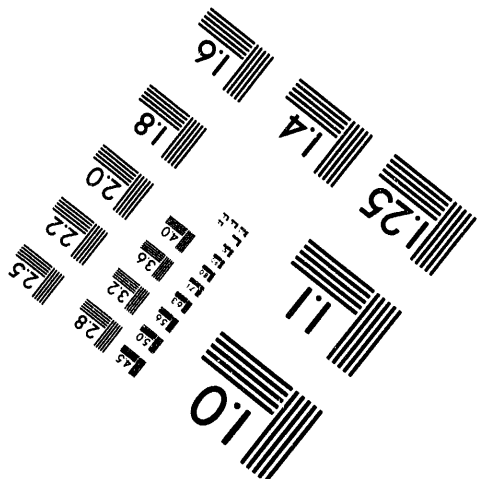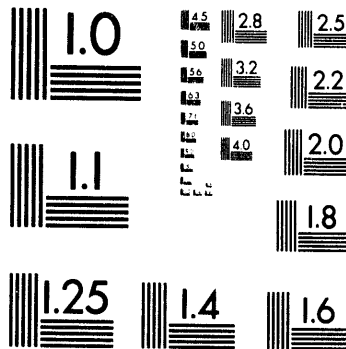
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Centimeter

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Inches

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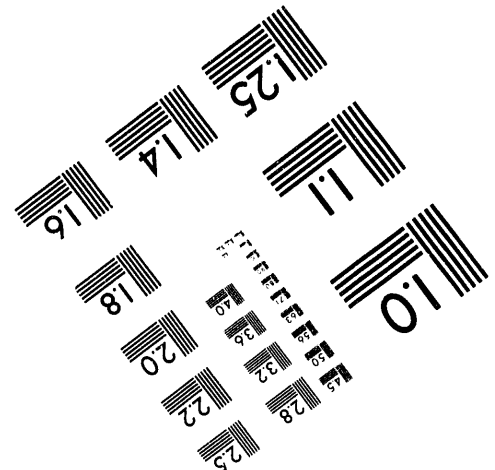
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1 of 1

DOE/BC/14831--10

ASSIST IN THE RECOVERY OF BYPASSED OIL FROM RESERVOIRS IN THE GULF OF MEXICO

Contract Number: DE-AC22-92BC14831

Louisiana State University
Department of Petroleum Engineering
Baton Rouge, LA 70803-6417

Contract Date: February 18, 1992
Anticipated Completion Date: August 18, 1994
Total Government Award: $2,025,755

Principal Investigator: Philip A. Schenewerk

Project Manager: Gene Pauling
                 Metairie Project Office

Quarterly Status Report (Final): Covering January 1, 1994 - March 31, 1994

Report Date: May 30, 1994

US/DOE Patent Clearance is **not** required prior to publication of this document.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

History matching and prediction runs have been completed on the B-35-K reservoir, history matching has been completed on the B-65-G reservoir and on Reservoir 3.

Modifications to BOAST II and MASTER consisted of developing codes to handle steeply dipping oil reservoirs and a radial grid format for near wellbore studies. Modifications for steeply dipping reservoirs have been successfully implemented and tested against commercial simulators in the PC version of BOAST II, renamed BOAST III. At present, modifications to BOAST II for radial grid systems are producing acceptable results in a 2-D model. A paper was presented at the 1994 ACM Symposium on Applied Computing in Phoenix, Arizona, March 6-8, 1994 on these results. Modifications have also been succesfully implemented in the MASTER simulator. It is presently undergoing industry testing for validity.

Laboratory investigations continued but were slowed by several unforeseen incidences involving broken apparatus and inability to recieve parts due to the California earthquake.

Predictive models for undeveloped oil and immiscible/miscible processes began. The methodology for determination of undeveloped potential has been completed. The design of the miscible and updip displacement models as well as the design of the economic and timing models is underway. The coding and calibration of the models will begin soon.

INTRODUCTION

Much of the remaining oil offshore is trapped in formations that are extremely complex due to intrusions of salt domes. Conventional seismic processing techniques cannot clearly image either these traps or the full extent of oil-bearing segments near the salt domes; therefore, substantial volumes of oil may have remained uncontacted by previous drilling.

Recently, however, significant innovations have been made in seismic processing and mathematical migration of seismic signal. In addition, significant advances have been made in deviated and horizontal drilling technologies and applications. These technology advances make it possible to reprocess existing seismic data to identify non-contacted portions of the reservoirs, which can then be contacted using advanced drilling technologies to kick out new wells from existing wells. Effective application of these technologies, along with improved recovery methods, offers opportunities to significantly increase Gulf of Mexico production, delay platform abandonments, and preserve access to a substantial remaining oil target for enhanced recovery and other advanced recovery processes.

PROJECT DESCRIPTION

The objective of this research is to assist the recovery of non contacted oil from known reservoirs on the Outer Continental Shelf in the Gulf of Mexico. Mature offshore reservoirs, declining oil reserves, declining production, and other natural forces are accelerating the abandonment of offshore oil resources and production platforms. As these offshore wells are plugged and the platforms are abandoned, an enormous volume of remaining oil will be permanently abandoned. Significant quantities of this oil could be recovered using advanced technologies now available if the resource can be identified.

This project will proceed under three broad phases:

Analysis -- TORIS level data will be collected on the major fields located in the piercement salt dome province of the Gulf of Mexico Outer Continental Shelf. Representative reservoirs will be studied in detail in order to evaluate undeveloped and attic oil reserve potential. These detailed investigations will be used to calibrate the TORIS level predictive models. The recovery potential of advanced secondary and enhanced oil recovery processes and the exploitation of undeveloped and attic oil zones for salt dome reservoirs in the Gulf of Mexico will be assessed.

Supporting Research -- Supporting research will focus on the modification of public domain reservoir simulation models to accurately simulate the conditions encountered in the piercement salt dome province of the Gulf of Mexico. Laboratory research will focus on the development of fluid relationships that will be used in the simulation of miscible and immiscible processes in the project area.

Technology Transfer -- A significant effort is planned to transfer the results of this project to potential users of the technology. Technology transfer activities will also provide feedback channels that will help keep the analysis and supporting research focused on the most important problems associated with this project.

PROJECT STATUS AND PLANNED ACTIVITIES

Data Analysis

Analysis continued on Reservoir 3 in Field 2. The preliminary draft report on the results of the history match on Reservoir 3 of Field 2 was modified to reflect comments from review. No comments were made on the history match itself and so efforts shifted to predictive studies. Efforts are focusing on the performance of the reservoir over ten years as a function of water injection. The operator of the field is also making predictive studies based on a waterflood and three new vertical wells. These results will be used to estimate the amount of potentially bypassed oil in the reservoir and also to complete the validation of the BOAST III model.

Documentation for the simulation of the B-65-G Sand reservoir, in South Marsh 73 Field, also were being prepared.

Critical Process Parameter Laboratory Experiments

Experiments for the study of attic oil recovery techniques are currently underway. A delay arose with the delivery of a valve from a company in California due to the earthquake.

MASTER Modification

Modifications to MASTER have been completed and are currently undergoing testing within the industry.

BOAST II Modification

Modifications to BOAST continue with no unforseen problems or delays. A copy of a modified copy of the PC version of BOAST II, BOAST III, continues being validated against a proprietary industry simulator.

Modifications to the mainframe version continue. Currently, the implementation of our dynamic mesh routines on the parallel architectures is being studied, recognizing the fact that efficient load-balancing will become a

major issue. Much of the work from the past few years is being compiled as a doctoral dissertation. Parts of the dissertation, particularly parallel implementation, are intended for publication. A paper was presented at the 1994 ACM Symposium on Applied Computing in Phoenix, Arizona, March 6-8, 1994 on these results[1]. A copy of this paper has been included in the Appendix. Testing of this method on areal sweep efficiencies is continuing and should be completed soon.

TORIS Predictive Modelling

Predictive models for undeveloped oil and immiscible/miscible processes were begun. The methodology for determination of undeveloped potential has been completed. The design of the miscible and updip displacement models as well as the design of the economic and timing models is underway. The coding and calibration of the models will begin soon.

The models must permit evaluation of all federal options and are being designed to allow this. Figure 1 illustrates the outline of options. They include no action, technology development and policy action. Required models include process models, timing models and economic models.

Outputs also must be designed for a wide range of variable inputs. Variables include oil prices, tax treatment, technology penetration, environmental regulation and costs. Model outputs include oil, water rates versus time, govt revenue vs. time, platform/field abandonments, new wells drilled, capital investments, environmental compliance costs and injectant demand. Aggregated outputs include incremental reserves, incremental production and incremental revenue.

SUMMARY OF PROGRESS

Detailed reservoir studies on Reservoir 3 Field 2 and the B-65G Reservoir in South Marsh Island Block 73 Field continued. History matching has been completed on both and predictive runs are in progress. Calibration and comparisons of the BOAST III simulator continue also with good results thus far.

Predictive models for undeveloped oil and immiscible/miscible processes began. The methodology for determination of undeveloped potential has been completed. The design of the miscible and updip displacement models as well as the design of the economic and timing models is underway. The coding and calibration of the models will begin soon.

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REFERENCES

1. Morton, D.J., Tyler, J.M., Bourgoyne, A.T., Schenewerk, P.A.: "An Adaptive Finite Element Methodology For 2D Simulation of Two-Phase Flow Through Porous Media." Proceedings of the 1994 ACM Symposium on Applied Computing, March 6-8, 1994, pp 357-362.

PUBLICATIONS

Morton, D.J., Tyler, J.M., Bourgoyne, A.T., Schenewerk, P.A.: "An Adaptive Finite Element Methodology For 2D Simulation of Two-Phase Flow Through Porous Media." Proceedings of the 1994 ACM Symposium on Applied Computing, March 6-8, 1994, pp 357-362.

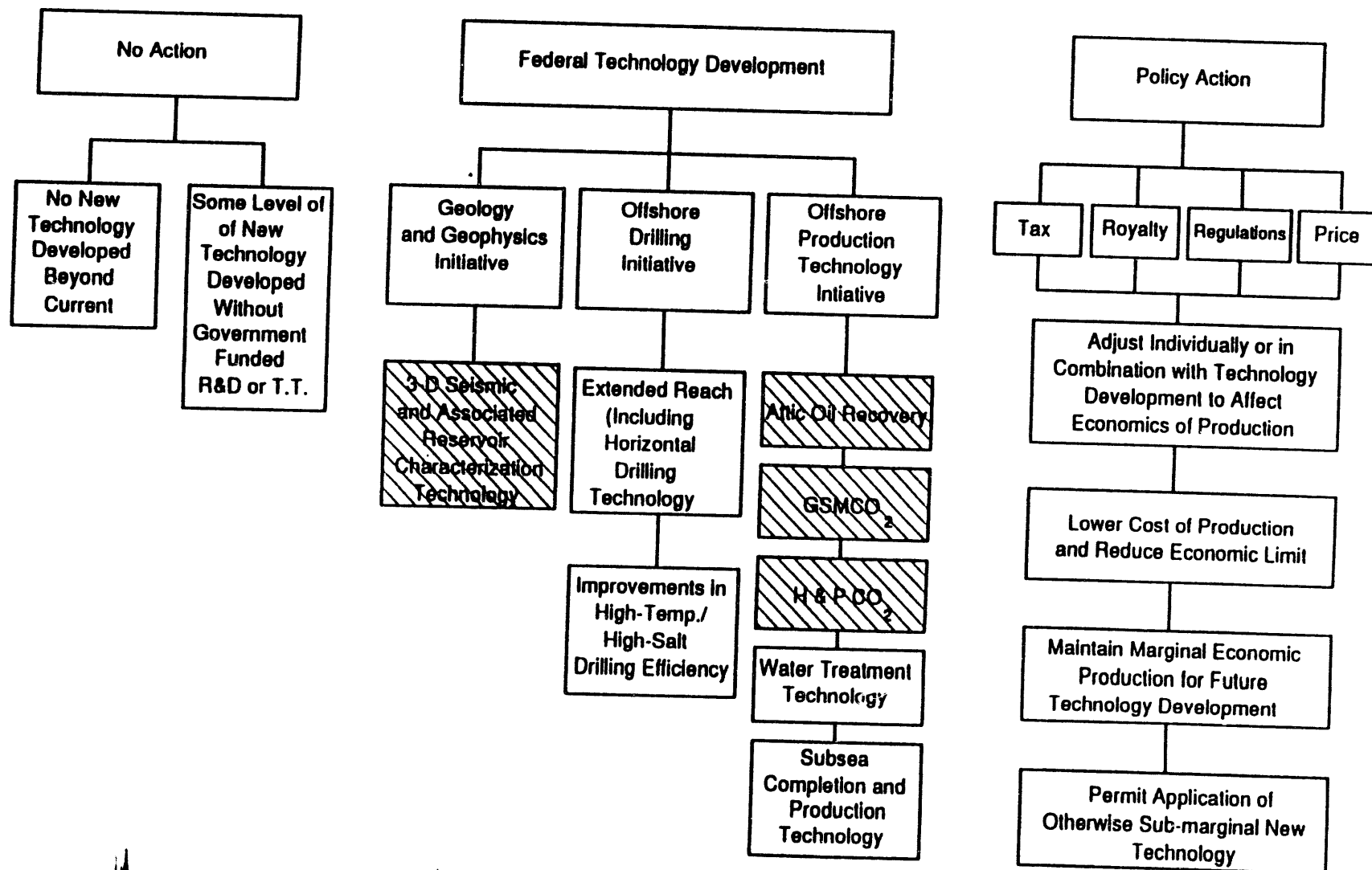# Models Must Permit Evaluation of All Federal Options

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┌──────────────────┐          ┌────────────────────────────────┐          ┌──────────────────┐
│    No Action     │          │  Federal Technology Development │          │   Policy Action  │
└──────────────────┘          └────────────────────────────────┘          └──────────────────┘
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No Action

| No New Technology Developed Beyond Current | Some Level of of New Technology Developed Without Government Funded R&D or T.T. |

Federal Technology Development

| Geology and Geophysics Initiative | Offshore Drilling Initiative | Offshore Production Technology Intiative |

- 3-D Seismic and Associated Reservoir Characterization Technology

- Extended Reach (Including Horizontal Drilling Technology)
- Improvements In High-Temp./ High-Salt Drilling Efficiency

- Artic Oil Recovery
- GSMCO₂
- H & P CO₂
- Water Treatment Technology
- Subsea Completion and Production Technology

Policy Action

| Tax | Royalty | Regulations | Price |

- Adjust Individually or in Combination with Technology Development to Affect Economics of Production
- Lower Cost of Production and Reduce Economic Limit
- Maintain Marginal Economic Production for Future Technology Development
- Permit Application of Otherwise Sub-marginal New Technology

FIGURE 1

END

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10/14/94