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**APPLICATION OF INTEGRATED RESERVOIR MANAGEMENT
AND RESERVOIR CHARACTERIZATION
TO OPTIMIZE INFILL DRILLING**

Cooperative Agreement Number: DE-FC22-94BC14989

FINA OIL AND CHEMICAL COMPANY

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Reporting Period: March 13, 1996 to June 12, 1996

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QUARTERLY TECHNICAL PROGRESS REPORT

"APPLICATION OF INTEGRATED RESERVOIR MANAGEMENT AND RESERVOIR CHARACTERIZATION TO OPTIMIZE INFILL DRILLING"

INSTRUMENT NO. DE-FC22-94BC14989

**NORTH ROBERTSON UNIT DEPARTMENT OF ENERGY
CLASS II OIL PROGRAM PROJECT**

REPORTING PERIOD: 3/13/96 TO 6/12/96

This Quarterly Progress Report summarizes the technical progress of the project from 3/13/96 to 6/12/96.

ACTIVITY II.1 - MANAGEMENT AND ADMINISTRATION

PROJECT MANAGEMENT AND ADMINISTRATION - TASK II.1.1

Project Status

At this stage, the main emphasis is on the Field Demonstration phase of the project. The drilling portion of the Field Demonstration has been divided into two separate phases. We are currently proceeding with the drilling and completion of the first eleven Phase I wells. Locations for the additional seven Phase II wells were chosen at a Technical Committee meeting during the first week of June. Preliminary results have been very encouraging as all the wells are producing at or above their forecasted rates.

Phase I includes the drilling of four producers and one injection well (10-acre nominal spacing) in both the Section 329 study area and the Section 326/327 study area, as well as one producing well in Section 362 (Fig. 1). Phase I will be completed during the first week of July.

Phase II drilling will involve the completion of the waterflood patterns to the west of the Phase I areas in Sections 329 and 327, consisting of two producers and one injection well in each area (Fig. 2). The final Phase II well will be located near the southwest corner of Section 324, in an area of the Unit that remains relatively undrained. Producer-injection well conversions will be performed in this area, as well as other peripheral areas of the Unit to add needed water injection.

PROJECT MANAGEMENT AND ADMINISTRATION - TASK II.1.1 (Cont'd)

The next Technical Committee meeting will be scheduled for the second week of July to discuss the integration and timing of each committee member's Budget Period II tasks.

ACTIVITY II.2 - FIELD DEMONSTRATION

IMPLEMENTATION OF FIELD DEMONSTRATION - TASK II.2.1

Drilling And Completion

All required drilling and injection permits have been obtained in a timely manner. The first producing well, NRU 3535, was spudded on March 17, 1996. At this time, nine of the eleven Phase I wells have been drilled, and five are currently producing from the entire productive interval or selected intervals (zonal testing). These wells will not flow naturally, and all must be placed on pump as they are completed.

The locations of the seven Phase II wells were chosen based on the analyses of all geological, petrophysical, and performance data acquired during the drilling of the Phase I wells.

Production pipelines are laid for each new producing well as they are put on production. Injection lines will be laid for the injection wells as they are completed. Several of these injection wells may be "pre-produced" for a three or four week period (as per the Texas RRC) prior to placing them on injection in order to obtain the early "flush" production in the near-well area that is a producing characteristic of this reservoir.

All data required for the validation of the Budget Period I Reservoir Characterization, Reservoir Management, and Reservoir Simulation Studies are being acquired and analyzed during the Field Demonstration Period.

Core Acquisition And Analysis

We will have cored 2,766 feet in four separate 10-acre infill wells by the end of the Phase I drilling period as part of an intensive effort to collect needed rock data. The data will be used to help quantify the extent of small scale vertical and lateral heterogeneity within the NRU Clearfork Formation.

We attempted to cut cores continuously through the entire Clearfork section. Parts of the section were not cored due to significant mechanical difficulties caused by very long core times--often greater than 200 minutes per foot. This continuous core gives us the ability to make foot by foot

IMPLEMENTATION OF FIELD DEMONSTRATION - TASK II.2.1 (Cont'd)

comparisons of reservoir quality, rock type, and depositional environment, which ultimately will help us correctly model fluid movement within the reservoir.

Fina geologists were very careful to capture high quality data from the core by following these rigorous procedures:

- 1) The core was pulled from the barrel and loaded into 6" PVC tubes that were immediately filled with degassed lease crude and then sealed.
- 2) The core was carefully laid out at the lab ensuring that care was taken to properly mark depths and lost core intervals.
- 3) 1" by 1" plugs were taken every foot, exactly 0.1 feet below the foot mark. These plugs were measured by Core Labs for mercury porosity, air permeability, and grain density. All of this data was loaded into a geological-petrophysical computer database program, then depth shifted.
- 4) "Whole" core analyses were taken at promising looking reservoir intervals. Data will be loaded into the computer database and depth corrected.
- 5) 1.5" by 3" Special Core Analysis (SCAL) plugs were taken in all potential reservoir intervals and in all rock types. These plugs were stored in sealed containers filled with degassed lease crude to preserve the native state of the rock characteristics and fluid content.

Mud Logging

We have captured continuous readings of all mud gas components while drilling, loaded the data into a computer database, and depth corrected it. In addition, we have started research into the applicability of using mud gas component ratios to estimate fluid content. It is hoped that flushed zones will have uniquely different ratios than uncontacted oil zones.

We have also noticed that the mud log is an excellent tool for locating the intervals that contribute most to production. In fact, in many cases it appears to do just as well as the base open hole log suites in the Clearfork/Glorieta interval. It should be noted, however, that the mud log does not yield an accurate measure of porosity, and it is not as accurate in cored wells where shows are diluted by very slow coring rates. In this particular shallow-shelf carbonate reservoir, it would appear that the pay intervals of interest could probably be cost-effectively defined simply by using the mud log and a base porosity and resistivity log. If an operator requires more detailed information regarding porosity types, rock quality, and fluid distributions, then additional information must obviously be gathered.

IMPLEMENTATION OF FIELD DEMONSTRATION - TASK II.2.1 (Cont'd)

Open-Hole Logging

The base logging suite for the 10-acre infill wells currently consists of a Dual Laterolog, Micro Laterolog or Micro-Spherically Focused Log (R_{xo} device), Compensated Neutron Log, Compensated Spectral or Litho-Density Log (includes PE), Spectral Gamma Ray Log, and a Sonic Log. We have utilized several potentially useful modern open hole log tools in addition to our normal logging suite in an attempt to more accurately characterize permeability, fluid content, and rock fabric. Some of these are summarized below:

High Frequency Dielectric Log

The high frequency (200 MHz) dielectric log yields a salinity-independent measure of fluid distributions in the flushed zone. This is of paramount importance in areas such as the North Robertson Unit which are currently under active waterfloods. The dielectric tool produces a much more accurate representation of pay intervals than can be obtained from the usual low frequency flushed zone resistivity devices, such as the MLL or MSFL, which do not always do a good job of differentiating between residual and movable hydrocarbons.

Traditional water saturation calculation techniques do not always produce accurate answers in fractured or vuggy carbonate formations. Since the flushed zone saturation can be calculated independent of the Archie saturation exponent or cementation factor (which are usually variable), the tool also produces more accurate flushed zone saturation calculations. This device works extremely well in formations with mixed lithology, and if run in combination with a low frequency flushed zone resistivity device, yields a rock textural parameter that can be used to determine the type of porosity present (intergranular, vuggy, or fracture), which directly affects the producibility of any particular interval.

NMR Log

Nuclear Magnetic Resonance (NMR) logs were recorded over selected sections of two cored wells in an effort to obtain permeability, lithology-independent porosity, pore size distribution, and fluid saturation distribution from a single log. Most of the preliminary NMR work has been performed to differentiate between oil and water in low-resistivity clastics, however, several recent projects performed in the Permian Basin area are adding to the understanding of NMR responses in high-resistivity carbonate reservoirs.

This device gave a reasonably good approximation of permeability, pore size, and the location of free hydrocarbons, however, data turnaround was slow, costly, and initially needs to be closely calibrated with core. The distribution of free and bound fluids in the rock pores obtained from

IMPLEMENTATION OF FIELD DEMONSTRATION - TASK II.2.1 (Cont'd)

NMR analysis of selected core samples from the two wells indicated that the reservoir is oil wet. This fluid distribution was then used in the processing of the raw log data to yield a visual representation of the pore and fluid distribution in the reservoir. Permeability is estimated using an empirical relationship involving the tool's porosity measurement and the T_2 time, or transverse relaxation time, required for a hydrogen molecule to re-orient itself after being "tipped" by a magnetic pulse from the tool.

Given the fact that permeability and pore size change so rapidly in the Clearfork, the vertical resolution of the next generation of tools probably needs to be improved, and this is currently underway. Plans are to continue to evaluate the application of NMR technology for the Clearfork.

Borehole Imaging Log

We attempted to obtain log-based images of the borehole wall in two cored wells using both circumferential microresistivity imaging tool and an acoustic-based imaging tool. The microresistivity imaging tool missed most of the small-scale features and many of the large scale features, most probably due to insufficient resistivity contrasts within the rock.

We were much more successful in identifying natural fractures, vugs, and bedding planes using the acoustic imaging tool, however, we still missed many of the small-scale features that are present in the core. We may attempt to record an additional acoustic-based image in one of the Phase II injection wells to determine the degree of fracture propagation caused by long-term injection along east-west injection rows. Plans are to aggressively pursue research on the usefulness of this tool as a means of imaging rock fabric.

New Well Completions

As a result of the data acquisition process (core and logs) during the Field Demonstration phase of the project we have found that we can identify discrete intervals within the Glorieta/Clearfork section that contribute most to production. These are intervals of relatively high permeability and porosity reservoir, which are separated by larger intervals of lower permeability and porosity rock that act as source beds for the higher quality reservoir rock. These intervals include:

Lower Clearfork:	MF4 and MF5 zones	($\pm 7,000'$ - $7,200'$)
Middle Clearfork:	MF1A, MF2, and MF3 zones	($\pm 6,350'$ - $6,500'$, and $\pm 6,750'$ - $6,900'$)
Upper Clearfork:	CF4 Zone	($\pm 6,150'$ - $6,250'$)

To date we have utilized three-stage completion designs to keep the treated intervals between 100 and 300 ft. We have performed both CO₂ foam fracs and conventional cross-linked borate

IMPLEMENTATION OF FIELD DEMONSTRATION - TASK II.2.1 (Cont'd)

fracs using a new premium frac fluid on an equal number of new wells, with outstanding results for both designs. The advantages of each type of frac design are listed below:

CO₂ Foam Fracs: exceptionally clean frac fluid
 increased relative oil permeability
 created solution gas drive reduces cleanup requirements
 formation of carbonic acid for near-well stimulation
 reduction in interfacial tension helps remove water blocks

Cross-linked Borate: exceptionally clean frac fluid
 low fluid loss without formation-damaging additives
 excellent proppant-carrying capacity
 polymer-specific enzyme breaker aids in post-frac cleanup
 90% of original fracture conductivity retained

Pre-frac cleanup acid jobs have been performed to remove near-well damage using between 1,000 and 3,000 gallons of 15% acid. Most intervals have been perforated for limited-entry fracturing (> 2 bbl/perf), with average injection rates between 30 and 40 barrels/minute, depending on the size of the interval. The size of the frac jobs has ranged from 35,000 gallons of fluid and 55,000 lbs of 16/30 sand to 70,000 gallons of fluid and 150,000 lbs of 20/40 sand. Resin-coated sand has been "tailed-in" for all frac jobs to reduce sand flowback during production. The conventional fracs have been flowed back immediately at 1 barrel/minute to induce fracture closure, while the foam fracs have been shut-in 2-5 days after stimulation to allow the CO₂ to soak into formation.

All jobs have been radioactively traced to estimate vertical fracture propagation. Using this information, we have been successful in avoiding fracturing down into an underlying water zone in the lower Clearfork, and we have been able to avoid any fracture communication between stages. All hydraulic fracture jobs have been designed to yield fracture half-lengths between 150 and 200 ft. Post-frac pressure transient tests performed over specific completion intervals indicate that we are obtaining fracture half-lengths on the order of 150 ft with average radial flow skin factors of approximately -5.5.

FIELD OPERATIONS AND SURVEILLANCE - TASK II.2.2

Operations

All new wells are being operated in accordance with Fina Oil and Chemical Company's normal operating procedures.

FIELD OPERATIONS AND SURVEILLANCE - TASK II.2.2 (Cont'd)

Production Tests

All new wells are placed on daily test for a period of two to three weeks, or until their rates have stabilized. 24-hour production tests are performed twice a month on each well (new and existing) in accordance with Fina's normal operating procedures.

Oil Fingerprinting

Surface oil samples have been collected from each interval completion on all new wells for oil fingerprinting analysis. The samples are currently being sent to D.B. Robinson Fluid Properties, Inc. in Houston, Texas for compositional analysis. The oil samples are processed using centrifuge and filtration processes to remove suspended water and other organic material to obtain the best representative sample from each producing interval.

As with most shallow-shelf carbonate reservoirs in the Permian Basin, we are dealing with a large productive interval, in which small individual zones contribute most of the production. Traditional methods for identifying zonal contributions do not work well in this Glorieta/Clearfork interval because the wells do not flow naturally. As an example, in order to record a production log survey, flow must be induced through artificial means that are not representative of the "normal" reservoir flow mechanisms.

We will work with D.B. Robinson to determine if this cost-effective technology is a viable method for estimating each producing interval's contribution to total production. The utilization of time-lapse temperature logs is also being investigated as a possible means of determining zonal contributions to total production. The information obtained from these tests and from the interval pressure transient tests we are currently performing will allow for better targeting of productive intervals in future wells, a reduction in completion costs, and a more efficient completion. We will continue to report on the progress/results of this program during the next few quarters.

TDT Logging

A second series of Thermal Decay Time (TDT) logs will be recorded during the third and fourth quarters of 1996 in the same wells in which data was collected during Budget Period I. We will measure the degree of change in formation water saturations, determine the effectiveness of current waterflood operations, and identify any intervals that may require recompletion. We will report the findings from these surveys during the next few quarters.

ACTIVITY II.3- INTEGRATION/VALIDATION

VALIDATION OF RESERVOIR CHARACTERIZATION - TASK II.3.1

Routine Core Analysis

Routine core analysis has been performed on all newly acquired core. Porosity and permeability measurements have been made over the entire cored interval on all the 1" by 1" quick plugs, as well as on the 4" whole core across selected reservoir intervals.

Thin Section Analyses

Numerous thin sections of the cored intervals have been prepared. Plans are to use information from these thin sections to enhance our understanding of pore size, pore distribution, rock type, and depositional environment.

Depositional Environments

We have completed cursory descriptions of depositional environment on 2,090 feet of core, and have discovered several significantly new features not noted from previous core descriptions.

The first is the presence of large patch reefs and associated porous debris aprons in the lower Clearfork within Section 327. Previous work suggested that a "shelf" edge existed east of Section 327, and that the large reefs would only exist along this shelf edge. This new core information implies that there is no shelf edge as such, just patch reefs and debris aprons scattered across the Unit. This information could help explain the erratic distribution of good producing wells in the south-central portion of the Unit. It is important to note that the debris aprons and shoals around these reefs typically have good reservoir quality. In addition, smaller and less well developed reefs and bioherms have been noted in the upper portions of the middle Clearfork and upper Clearfork.

The second new piece of information concerns the MF3 layer of the middle Clearfork which has been reinterpreted as a solution collapse breccia with associated open natural fractures. These features were caused by dissolution of carbonate beneath extensive exposure surfaces. The presence of these surfaces is supported by presence of coal beds, abundant "fresh" water plant debris zones, erosion lag soils, and some root casts. Parts of the Unit were only partially exposed, most probably as a series of small islands and associated carbonate sand beaches. This information is of important economic significance, because there is more natural fracturing in the MF3 zone than previously thought. Further analyses will determine the interconnection and influence of this fracturing from solution collapse breccias.

VALIDATION OF RESERVOIR CHARACTERIZATION - TASK II.3.1 (Cont'd)

Rock Fabrics

We have described four basic rock fabrics:

- 1) *Homogeneous*--which is made up of relatively uniformly distributed lateral and vertical porosity and permeability. The best example of this type of rock fabric is found within selected portions of the MF1A layer. We are not implying that this zone is perfectly homogeneous like some silica clastic sands, however this layer is much closer to this type of homogeneity than all other zones in the Clearfork.
- 2) *Fractured*--which is made up of solution collapse breccias as described previously. Fractures are 2-4 inches in length and very roughly estimated to be 4-6 inches apart. Not all of these fractures are open, as many have been plugged with anhydrite. Portions of the MF3 layer are a good example of this fabric.
- 3) *Bimodal*--which is made up of two distinct sizes of pores. The larger size pores are typically formed from the dissolution of fossil debris, and the smaller pores are typically intercrystalline in origin.
- 4) *Heterogeneous*--which is made up of anhydrite nodules, and porous dolostone. This fabric is common throughout much of the Clearfork/Glorieta section. The size and distribution of these anhydrite nodules varies dramatically.

Geological Conformance Analysis

We have continued to acquire and analyze injection profile and temperature data using our computer database for construction of conformance cross-sections, percent injection velocity maps, and percent injection intensity maps. Results of this information is used to better understand the efficiency of the waterflood in conjunction with numerous other geologic data (core, $\emptyset h$ maps, kh maps).

$\emptyset h$ and kh Mapping

As we have acquired additional open-hole log data, we have loaded it into the geological-petrophysical database and begun generating updated $\emptyset h$ and kh maps.

Mini-Permeameter Research

Approximately 150 feet of slabbed core from the newly drilled NRU 3533 well has been sent to Core Labs for mini-permeameter analysis. This tool has the ability to take multiple permeability and porosity measurements in a very small grid across the surface of slabbed core.

VALIDATION OF RESERVOIR CHARACTERIZATION - TASK II.3.1 (Cont'd)

Data from this testing will be used to better understand very small scale changes in reservoir quality for various Clearfork rock types and upward shallowing carbonate cycles. In addition, this data may help us better understand ϕ vs. k relationships which typically are quite "scattered" for most Clearfork reservoir rocks. We plan to also send the slabbed core to the University of Tulsa for additional testing on their mini-permeameter machine.

This permeability and porosity data will be compared to plug and whole core data to address scale issues with regard to data that should be used for subsequent reservoir flow simulation.

Updating the Core-Log Model

We have completed extensive work on improving the porosity vs. permeability algorithms used in the early phases of this project. Results to date indicate that several new lines of research hold promise:

- 1) Generation of ϕ vs. k plots for each shallowing upward carbonate cycle (previously called flow unit tops).
- 2) Generation of ϕ vs. k plots for each depositional environment.
- 3) Use of Neural-Network programs to identify characteristic sequences based on core and log responses.
- 4) Improvement of the old core-log algorithms using new open-hole log data.
- 5) Formulation of unique ϕ vs. k relationships for small areas of the field related to the ϕ vs. k relationships for the core in that area.

Fina Geologists will work closely with David K. Davies & Associates, Inc. in order to combine these various techniques and formulate the best method or combinations of methods to obtain optimal permeability-porosity relationships.

Special Core Analysis (SCAL)

Approximately 120 preserved SCAL plugs have been cut from the new core in order to obtain a representative sampling of the reservoir interval in all "pay" rock types that were defined during Budget Period I. The SCAL plugs will be further screened using a CT scan machine at Texas A&M University to eliminate the plugs that possess major barriers to flow, which is almost always in the form of anhydrite nodules. We will then perform wettability, relative permeability, capillary pressure, and electrical properties measurements on the screened plugs to update our database for reservoir flow simulation. We are currently going through a bid process to determine which lab will perform these tests. Results will be updated during the next few Quarterly Reports.

VALIDATION OF RESERVOIR MANAGEMENT ACTIVITIES AND PERFORMANCE ANALYSIS - TASK II.3.2

Material Balance Decline Curve Analysis

We will soon begin analyzing early production data from new wells utilizing material balance decline type curve methodologies formulated during Budget Period I. Early rate and fluid level measurements will allow us to verify the results of previous analyses and obtain early estimates of individual well potentials, bottomhole pressures, and formation flow characteristics. The results of this work will be reported in the next few Quarterly Reports.

Formation Testing

The formation test tool has provided individual layer pressures that can be used to better understand the way in which the productive intervals deplete and repressure across the Unit. This can be used not only as a formation evaluation tool, but also as a reservoir conformance tool in an active waterflood. Unfortunately, testing a low permeability, heterogeneous formation, such as the Clearfork, is extremely difficult.

We utilized a low-force snorkel, a slow-drawdown choke with a very small pretest chamber (5 cc), and a very soft packer pad (60 durometer) in order to have any chance at obtaining valid formation pressures. In addition, it is important to "mud-up" prior to reaching total depth to ensure the presence of a stable mudcake prior to logging as all of these wells are drilled with brine water. Even taking the preceding precautions, we were only able to obtain valid pressures on about 15-20% of the tool sets – a direct result of the vertical heterogeneity and low permeability of the Glorieta/Clearfork interval.

Pressure Transient Tests

Short-term pressure drawdown tests are being used to estimate reservoir pressure and formation flow characteristics in the new producing wells. At this time, we prefer to record drawdown rather than buildup tests to avoid the shut-in of recently completed wells. These tests are being recorded over individual completion intervals (i.e., lower, middle, or upper Clearfork), and are also being used to estimate the completion efficiency and the relative contribution of each zone to total production. This information will aid in injection well profile modification work to be performed during Budget Period II.

To date, we have recorded both a lower and middle Clearfork test in the Section 329 area, and lower and middle Clearfork tests in the Section 327 infill area. We have found that the hydraulic fracture jobs have been successful and are producing fractures with half-lengths on the order of 150 ft (skin factor = -5.5). Results also indicate that the middle Clearfork is a much more significant contributor to total production in both areas of the Unit than was previously thought. We also feel that the upper Clearfork and Glorieta sections contribute very little to total

VALIDATION OF RESERVOIR MANAGEMENT ACTIVITIES AND PERFORMANCE ANALYSIS - TASK II.3.2 (Cont'd)

production in both areas of the Unit. This information, together with newly acquired core and log data, has allowed us to target our completion intervals much more effectively.

We will perform additional pressure drawdown tests across selected completion intervals during the next quarter. In addition, we will perform extended pressure buildup tests on half of the new producing wells during Budget Period II as a part of the reservoir surveillance program. Pressure falloff tests will be recorded on all new injection wells after completion. Results will be reported as they become available.

Injection Profiles

The results of approximately 25 injection profiles recorded during the second quarter of 1996 indicate the need for a revised injection well workover plan. Many of the injectors contain large amounts of fill, and other wells inject into only a very small percentage of the total productive interval (usually the lower Clearfork). We will focus on improving injection efficiency in the new injectors by identifying the intervals in the producing wells that are the largest contributors to total production. Rather than attempting to inject water across a large 1,200 ft interval as was done previously, we will attempt to target fairly small, specific intervals. Profile modification may be attempted in existing injectors, and an effort will be made during the completion of new injection wells to avoid high permeability streaks that take most of the injection water.

VALIDATION OF RESERVOIR SIMULATION - TASK II.3.3

Geostatistical Modelling

Prior to the last quarter, a reservoir flow model of the Section 329 study area was developed based on a single realization of a geostatistical reservoir description. This model was history-matched to actual production data and then used to forecast production performance under various development scenarios. The forecasts were used to select the best infill drilling pattern and to rank the individual well locations in the study area.

During the last quarter, four additional realizations of the geostatistical model were upscaled and history matched. The new porosity and permeability fields were upscaled to the reservoir flow model grid as in the first realization. Other model parameters were set to the same values as in the first realization, except that well skin factors were adjusted in each to control well bottomhole pressures. The new models were then used to forecast the production performance of the study area with infill drilling on a line drive pattern, as is currently being implemented in the field.

VALIDATION OF RESERVOIR SIMULATION - TASK II.3.3 (Cont'd)

The spreads in the oil rate forecasts from the different realizations provided a measure of the uncertainty in the forecasts due to the uncertainty in the porosity and permeability fields. In general, the spreads which resulted in this study were too narrow, reflecting an unrealistic lack of uncertainty in the forecasts. The suspected reason for this is that the spatial distributions of the porosity and permeability were modelled with too much horizontal continuity, due to the estimated ranges of the corresponding variograms being too high. Some of these variogram ranges could not be determined directly from the data since they are shorter than the distances between wells.

More work is planned to improve the definition of the uncertainty in the reservoir model forecasts. New log and core data are being obtained from more closely spaced infill wells that will allow the spatial continuity of the porosity and permeability fields to be examined on a finer scale. Also, additional realizations of the reservoir model will be generated with less horizontal continuity, and then will be used to forecast reservoir performance as above. The effect of the horizontal continuity on the forecast spreads will then be observed.

Deterministic Modelling

The number of model layers may be reduced as we gain a better understanding of reservoir flow mechanisms from data acquired during the Field Demonstration phase of the project. We will also investigate the use of a dual-porosity simulation model to better capture the behavior of a reservoir with high permeability productive streaks surrounded by large intervals of low permeability rocks that may act as a hydrocarbon source for those high-perm productive intervals.

All simulation models will be updated to incorporate changes in reservoir description (rock types), PVT, and special core properties as they become available during Budget Period II. If the number of reservoir layers in the simulation models can be significantly reduced, then several of the model areas may be combined into a larger simulation model to eliminate the requirement for making assumptions regarding boundary flux in each model area.

ACTIVITY II.4- TECHNOLOGY TRANSFER

REPORT WRITING - TASK II.4.1

A Continuation Application was supplied to the DOE at the end of Budget Period I. A Topical Report containing general field information, reservoir description, field development history, production constraints and design logic, evaluation of cost share project results, as well as any

REPORT WRITING - TASK II.4.1 (Cont'd)

additional supporting data is still being prepared at this time. The 1996 Annual Report is also currently being prepared.

NEWSLETTERS - TASK II.4.2

The second Project Newsletter will be distributed during the first quarter of 1997. The first newsletter, distributed during the fourth quarter of 1995, has had extremely favorable reviews.

PUBLICATIONS AND PRESENTATIONS - TASK II.4.3

Published Papers and Professional Meeting Presentations:

- SPE Permian Basin Oil and Gas Recovery Conference, March 27-29, 1996, Midland, TX.
 - SPE 35183, "Identification and Distribution of Hydraulic Flow Units in a Heterogeneous Carbonate Reservoir: North Robertson Unit, West Texas."
 - SPE 29594, "An Integrated Geologic and Engineering Reservoir Characterization of the North Robertson (Clearfork) Unit."
 - SPE 35161, "Pressure Transient Data Acquisition and Analysis Using Real Time Electromagnetic Telemetry."
 - SPE 35205, "Evaluation of Injection Well Performance Using Decline Type Curves."
- SPE/DOE Symposium on Improved Oil Recovery, April 21-24, 1996, Tulsa, OK.
 - SPE/DOE 35433, "Flow Unit Characterization of a Shallow Shelf Carbonate Reservoir: North Robertson Unit, West Texas."

TECHNOLOGY TRANSFER PACKAGES - TASK II.4.4

Technology transfer packages describing the results and methodologies used to date for this project will be distributed at the Technical Workshops and will be made available to all interested parties on a continuous basis. The packages will include the results of our analyses, and any software generated as a result of the work performed on this project. These packages will be updated during Budget Period II as more results become available.

TECHNICAL WORKSHOPS - TASK II.4.5

The first Technology Transfer Workshop was held in Midland, Texas on April 25-26, 1996 for approximately 60 industry personnel. A written report, "Integrated Reservoir Management and Characterization to Optimize Field Development," containing the results of our current analyses, associated technical publications, and computer software generated as a result of the work performed on the project, was given to all attendees. The subject areas attracting major interest were geological reservoir characterization, reservoir performance analysis, and the comparison of deterministic and geostatistical flow modelling.

The second workshop will be held June 13-14, 1996 in Houston, Texas, for approximately 45 participants.

Section 329, Phase I
5 Wells

Section 327, Phase I
5 Wells

Section 362, Phase I
1 Well

C.C.S.D. & R.G.N.G.
BLK. G

W.T. R.R.
BLK. G

PUBLIC SCHOOL LAND
BLK. AX

PUBLIC SCHOOL LAND
BLK. AX

FIGURE 1

NORTH ROBERTSON UNIT
GAINES COUNTY, TEXAS
BUDGET PERIOD II
DEVELOPMENT AREA
PHASE I DRILLING
11 WELLS TOTAL