

OILFIELD RESEARCH LABORATORIES

536 NORTH HIGHLAND - CHANUTE, KANSAS 66720 - PHONE (316) 431-2650

August 26, 1982

Tarc Drilling & Field Service
Rural Route # 3
Iola, Kansas 66749

Gentlemen:

Enclosed herewith is the report of the analysis of the rotary core taken from the Richard-B 1979-1 Lease, Well No. 14, located in Allen County, Kansas and submitted to our laboratory on August 19, 1982.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Sanford A. Michel

SAM/rmc

5 c to Iola, Kansas

- REGISTERED ENGINEERS -

CORE ANALYSIS - WATER ANALYSIS - REPRESSURING ENGINEERING - SURVEYING & MAPPING - PROPERTY EVALUATION & OPERATION

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GENERAL INFORMATION & SUMMARY

Company Tarc Drilling & Field Service Lease Richard-B 1979-1 Well No. 14
 Location 1100' FNL & 1540' FEL, NW¼
 Section 27 Twp. 25S Rge. 19E County Allen State Kansas

| | |
|------------------------------------|--------------|
| Elevation, Feet | |
| Name of Sand | Bartlesville |
| Top of Core | 826.0 |
| Bottom of Core | 846.0 |
| Top of Sand | 826.0 |
| Bottom of Sand | 845.5 |
| Total Feet of Permeable Sand | 15.4 |
| Total Feet of Floodable Sand | 3.0 |

| Distribution of Permeable Sand: Permeability Range Millidarcys | Feet | Cum. Ft. |
|--|------|----------|
| 0 - 5 | 6.4 | 6.4 |
| 5 - 10 | 3.8 | 10.2 |
| 20 - 40 | 1.9 | 12.1 |
| 40 - 61 | 3.3 | 15.4 |

| | |
|--|---------------------------|
| Average Permeability Millidarcys | 16.6 |
| Average Percent Porosity | 16.5 |
| Average Percent Oil Saturation | 34.6 |
| Average Percent Water Saturation..... | 40.9 |
| Average Oil Content, Bbls./A. Ft..... | 466. |
| Total Oil Content, Bbls./Acre..... | 7,182. |
| Average Percent Oil Recovery by Laboratory Flooding Tests..... | 8.0 |
| Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. | 117. |
| Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre | 352. |
| Total Calculated Oil Recovery, Bbls./Acre..... | See "Calculated Recovery" |

Section

The core was sampled and the samples sealed in plastic bags by a representative of the client. Fresh water mud was used as a drilling fluid.

FORMATION CORED

The detailed log of the formation cored is as follows:

| <u>Depth Interval, Feet</u> | <u>Description</u> |
|---------------------------------|---|
| 826.0 - 827.0 | Grayish light brown shaly sandstone. |
| 827.0 - 828.1 | Grayish light brown very shaly sandstone. |
| 828.1 - 829.0 | Light brown sandstone. |
| 829.0 - 830.0 | Grayish light brown slightly shaly sandstone. |
| 830.0 - 831.3 | Gray shale with widely scattered brown sandstone partings. |
| 831.3 - 832.0 | Grayish brown shaly sandstone. |
| 832.0 - 833.5 | Brown sandstone. |
| 833.5 - 837.0 | Grayish brown shaly sandstone. |
| 837.0 - 837.5 | Brown slightly shaly sandstone. |
| 837.5 - 838.0 | Gray very shaly sandstone. |
| 838.0 - 839.0 | Brown sandstone. |
| 839.0 - 839.9 | Brown shaly sandstone. |
| 839.9 - 842.2 | Gray shale. |
| 842.2 - 844.0 | Dark brown sandstone. |
| 844.0 - 845.3 | Dark brown slightly shaly sandstone containing a vertical fracture. |
| 845.3 - 845.5 | Brown shaly sandstone. |
| 845.5 - 846.0 | Gray shale. |

LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 352 barrels of oil per acre was obtained from 3.0 feet of sand. The weighted average percent oil saturation was reduced from 39.0 to 31.0, or represents an average recovery of 8.0 percent. The weighted average effective permeability of the samples is 3.19 millidarcys, while the average initial fluid production pressure is 31.3 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 17 samples tested, 4 produced water and oil, and 4 produced water only. This indicates that approximately 24 percent of the sand represented by these samples is floodable pay sand.

CALCULATED RECOVERY

It would appear from a study of the core data, that efficient primary and waterflood operations in the vicinity of this well should recover approximately 890 barrels of oil per acre. This is an average recovery of 298 barrels per acre foot from 3.0 feet of floodable sand analyzed in this core.

These recovery values were calculated using the following data and assumptions:

| | |
|--|------|
| Original formation volume factor, estimated | 1.04 |
| Reservoir water saturation, percent, estimated | 20.0 |
| Average porosity, percent | 18.6 |
| Oil saturation after flooding, percent | 31.0 |
| Performance factor, percent, estimated | 45.0 |
| Net floodable sand, feet | 3.0 |

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Tarc Drilling & Field Service

Lease Richard-B 1979-1

Well No. 14

| Sample No. | Depth, Feet | Effective Porosity Percent | Percent Saturation | | | Oil Content Bbls. / A Ft. | Perm., Mill. | Feet of Sand | | Total Oil Content | Perm. Capacity Ft. X md. |
|------------|-------------|----------------------------|--------------------|-------|-------|---------------------------|--------------|--------------|----------|-------------------|--------------------------|
| | | | Oil | Water | Total | | | Ft. | Cum. Ft. | | |
| 1 | 826.5 | 16.6 | 22 | 48 | 70 | 283 | 1.1 | 1.0 | 283 | 1.10 | |
| 2 | 827.6 | 8.0 | 35 | 60 | 95 | 217 | 0.84 | 1.1 | 239 | 0.92 | |
| 3 | 828.7 | 19.6 | 21 | 41 | 62 | 319 | 30. | 0.9 | 287 | 27.00 | |
| 4 | 829.7 | 12.2 | 32 | 61 | 93 | 303 | 9.9 | 1.0 | 303 | 9.90 | |
| 5 | 831.8 | 15.9 | 27 | 45 | 72 | 333 | 1.5 | 0.7 | 233 | 1.05 | |
| 6 | 832.4 | 19.2 | 37 | 28 | 65 | 551 | 21. | 1.0 | 551 | 21.00 | |
| 7 | 833.4 | 19.0 | 34 | 28 | 62 | 501 | 54. | 0.5 | 251 | 27.00 | |
| 8 | 834.5 | 14.7 | 20 | 57 | 77 | 228 | 1.6 | 1.5 | 342 | 2.40 | |
| 9 | 835.5 | 13.7 | 11 | 55 | 66 | 117 | 2.9 | 1.0 | 117 | 2.90 | |
| 10 | 836.5 | 15.0 | 24 | 52 | 76 | 279 | 5.0 | 1.0 | 279 | 5.00 | |
| 11 | 837.3 | 16.0 | 30 | 40 | 70 | 372 | 8.3 | 0.5 | 186 | 4.15 | |
| 12 | 838.4 | 18.5 | 48 | 25 | 73 | 689 | 60. | 1.0 | 689 | 60.00 | |
| 13 | 839.7 | 17.7 | 35 | 29 | 64 | 481 | 3.1 | 0.9 | 433 | 2.79 | |
| 14 | 842.4 | 20.6 | 70 | 19 | 89 | 1119 | 51. | 0.8 | 895 | 40.80 | |
| 15 | 843.8 | 18.7 | 46 | 32 | 78 | 667 | 40. | 1.0 | 667 | 40.00 | |
| 16 | 844.6 | 20.7 | 56 | 24 | 80 | 899 | 7.5 | 1.3 | 1169 | 9.75 | |
| 17 | 845.4 | 22.2 | 75 | 14 | 89 | 1292 | 1.6 | 0.2 | 258 | 0.32 | |

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Tarc Drilling & Field Service Lease Richard-B 1979-1 Well No. 14

| Depth Interval, Feet | Depth Interval, Feet | Feet of Core Analyzed | Average Permeability, Millidarcys | Permeability Capacity Ft. x Md. | Average Percent Porosity | Average Percent Oil Saturation | Average Percent Water Saturation | Average Oil Content Bbl./A. Ft. | Total Oil Content Bbls./Acre |
|-------------------------|-------------------------|--------------------------|---|---------------------------------------|--------------------------------|--------------------------------------|--|---------------------------------------|------------------------------------|
| 826.0 - 839.9 | 826.0 - 839.9 | 12.1 | 13.7 | 165.21 | 15.6 | 28.4 | 45.4 | 347 | 4,193 |
| 842.2 - 845.5 | 842.2 - 845.5 | 3.3 | 27.5 | 90.87 | 20.2 | 57.5 | 24.6 | 906 | 2,989 |
| 826.0 - 845.5 | 826.0 - 845.5 | 15.4 | 16.6 | 256.08 | 16.5 | 34.6 | 40.9 | 466 | 7,182 |

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Tarc Drilling & Field Service Lease Richard-B 1979-1 Well No. 14

| Sample No. | Depth, Feet | Effective Porosity Percent | Original Oil Saturation | | Oil Recovery | | Residual Saturation | | Volume of Water Recovered cc* | Effective Permeability Millidarcys** | Initial Fluid Production Pressure Lbs./Sq./In. |
|------------|-------------|----------------------------|-------------------------|---------------|--------------|---------------|---------------------|---------|-------------------------------|--------------------------------------|--|
| | | | % | Bbbls./A. Ft. | % | Bbbls./A. Ft. | % Oil | % Water | | | |
| 1 | 826.5 | 16.1 | 23 | 287 | 0 | 0 | 23 | 47 | 0 | Imp. | - |
| 2 | 827.6 | 8.1 | 35 | 220 | 0 | 0 | 35 | 60 | 0 | Imp. | - |
| 3 | 828.7 | 19.4 | 21 | 316 | 0 | 0 | 21 | 50 | 44 | 0.67 | 35 |
| 4 | 829.7 | 12.3 | 32 | 305 | 0 | 0 | 32 | 61 | 0 | Imp. | - |
| 5 | 831.8 | 16.0 | 27 | 335 | 0 | 0 | 27 | 51 | 18 | 0.30 | 45 |
| 6 | 832.4 | 19.3 | 37 | 554 | 8 | 120 | 29 | 44 | 8 | 0.30 | 45 |
| 7 | 833.4 | 18.9 | 34 | 499 | 4 | 59 | 30 | 55 | 150 | 2.33 | 20 |
| 8 | 834.5 | 14.8 | 20 | 230 | 0 | 0 | 20 | 64 | 10 | 0.37 | 50 |
| 9 | 835.5 | 13.9 | 11 | 119 | 0 | 0 | 11 | 56 | 0 | Imp. | - |
| 10 | 836.5 | 15.5 | 23 | 277 | 0 | 0 | 23 | 53 | 0 | Imp. | - |
| 11 | 837.3 | 16.1 | 30 | 375 | 2 | 25 | 28 | 47 | 8 | 0.30 | 50 |
| 12 | 838.4 | 18.8 | 48 | 700 | 13 | 190 | 35 | 55 | 264 | 7.95 | 10 |
| 13 | 839.7 | 17.6 | 35 | 478 | 0 | 0 | 35 | 30 | 0 | Imp. | 20 |
| 14 | 842.4 | 20.5 | 70 | 1113 | 0 | 0 | 70 | 23 | 160 | 2.39 | - |
| 15 | 843.8 | 18.2 | 47 | 664 | 0 | 0 | 47 | 31 | 0 | Imp. | - |
| 16 | 844.6 | 20.8 | 56 | 904 | 0 | 0 | 56 | 24 | 0 | Imp. | - |
| 17 | 845.4 | 22.1 | 75 | 1286 | 0 | 0 | 75 | 15 | 0 | Imp. | - |

Notes: cc—cubic centimeter.

*—Volume of water recovered at the time of maximum oil recovery.

**—Determined by passing water through sample which still contains residual oil.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

| | | | | | |
|---|-------------------------------|-------|------------------|----------|----|
| Company | Tarc Drilling & Field Service | Lease | Richard-B 1979-1 | Well No. | 14 |
| Depth Interval, Feet | 826.0 - 839.9 | | | | |
| Feet of Core Analyzed | 3.0 | | | | |
| Average Percent Porosity | 18.6 | | | | |
| Average Percent Original Oil Saturation | 39.0 | | | | |
| Average Percent Oil Recovery | 8.0 | | | | |
| Average Percent Residual Oil Saturation | 31.0 | | | | |
| Average Percent Residual Water Saturation | 50.0 | | | | |
| Average Percent Total Residual Fluid Saturation | 81.0 | | | | |
| Average Original Oil Content, Bbls./A. Ft. | 563. | | | | |
| Average Oil Recovery, Bbls./A. Ft. | 117. | | | | |
| Average Residual Oil Content, Bbls./A. Ft. | 446. | | | | |
| Total Original Oil Content, Bbls./Acre | 1,691. | | | | |
| Total Oil Recovery, Bbls./Acre | 352. | | | | |
| Total Residual Oil Content, Bbls./Acre | 1,339. | | | | |
| Average Effective Permeability, Millidarcys | 3.19 | | | | |
| Average Initial Fluid Production Pressure, p.s.i. | 31.3 | | | | |

NOTE: Only those samples which recovered oil were used in calculating the above averages.

PERMEABILITY, IN MILLIDARCY

--- EFFECTIVE PERMEABILITY TO WATER, IN MILLIDARCY

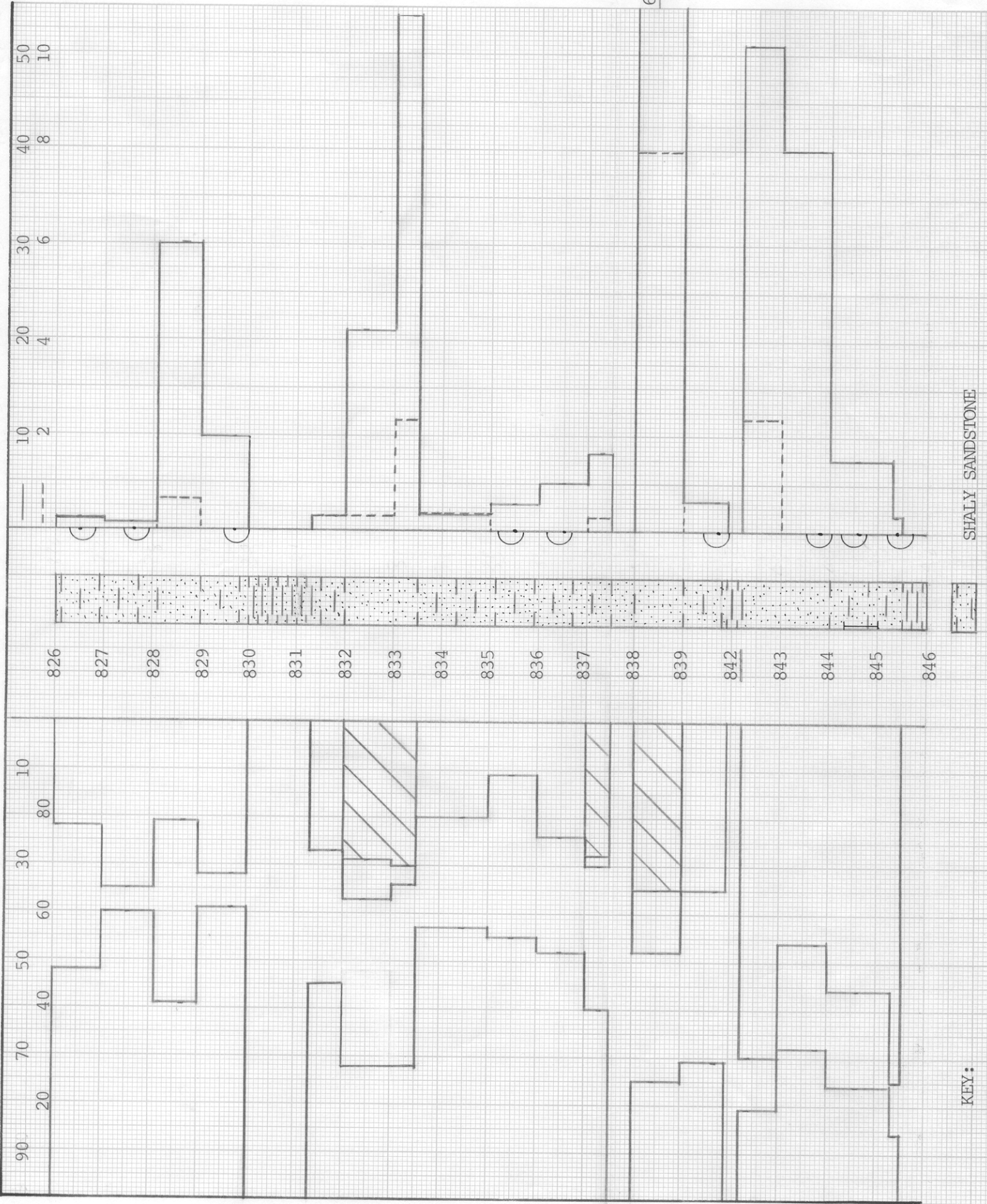
WATER SAL... PERCENT

→ ←

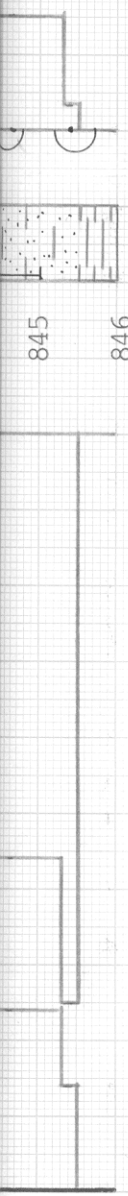
OIL SAL... PERCENT

→ ←

KEY:



SHALY SANDSTONE



KEY:



SANDSTONE



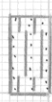
SHALE



IMPERMEABLE TO WATER



SHALY SANDSTONE



SHALE WITH SANDSTONE PARTINGS



FORMATION CONTAINING A VERTICAL FRACTURE



FLOODPOT RESIDUAL OIL SATURATION

TARC DRILLING & FIELD SERVICE

RICHARD-B 1979-1 LEASE

ALLEN COUNTY, KANSAS

WELL NO. 14

| DEPTH INTERVAL, FEET | FEET OF CORE ANALYZED | AVERAGE PERCENT POROSITY | AVG. OIL SATURATION PERCENT | AVG. WATER SATURATION PERCENT | AVERAGE PERMEABILITY, MILLIDARCS | CALCULATED OIL RECOVERY BBLs. / ACRE |
|----------------------|-----------------------|--------------------------|-----------------------------|-------------------------------|----------------------------------|--------------------------------------|
| 826.0 - 839.9 | 12.1 | 15.6 | 28.4 | 45.4 | 13.7 | |
| 842.2 - 845.5 | 3.3 | 20.2 | 57.5 | 24.6 | 27.5 | |
| 826.0 - 845.5 | 15.4 | 16.5 | 34.6 | 40.9 | 16.6 | 890 (PRIMARY AND WATERFLOODING) |

OILFIELD RESEARCH LABORATORIES
 CHANUTE, KANSAS
 AUGUST, 1982
 PDC