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Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

| | | | | |
|---|-----------------------------------|-----------------|----------------|---|
| Company | <u>Jackson Bros.</u> | Lease | <u>Crew</u> | Well No. <u>16</u> |
| Location | <u>NE NW NE</u> | | | |
| Section | <u>34</u> | Twp. <u>25S</u> | Rge. <u>8E</u> | County <u>Greenwood</u> State <u>Kansas</u> |
| Name of Sand | - - - - - Kansas City B'ville. | | | |
| Top of Core | - - - - - | | | 1909.0 2522.0 |
| Bottom of Core | - - - - - | | | 2040.5 2544.5 |
| Top of Sand | - - - - - | | | 1909.0 2527.3 |
| Bottom of Sand | - - - - - | | | 2040.5 2539.6 |
| Total Feet of Permeable Sand | - - - - - | | | 3.8 6.6 |
| Total Feet of Floodable Sand | - - - - - | | | - 6.0 |
| Distribution of Permeable Sand: | | | | |
| | Permeability Range Millidarcys | Feet | Cum. Ft. | |
| <hr/> | | | | |
| K.C. | 0 - 1 | 1.5 | 1.5 | |
| | 1 - 3 | 2.3 | 3.8 | |
| Bv. | 1 - 5 | 2.6 | 2.6 | |
| | 5 - 10 | 3.0 | 5.6 | |
| | 10 & above | 1.0 | 6.6 | |
| Average Permeability Millidarcys | - - - - - | | | 1.7 6.3 |
| Average Percent Porosity | - - - - - | | | 10.5 16.1 |
| Average Percent Oil Saturation | - - - - - | | | 32.1 23.4 |
| Average Percent Water Saturation | - - - - - | | | 36.8 63.8 |
| Average Oil Content, Bbls./A. Ft. | - - - - - | | | 280. 296. |
| Total Oil Content, Bbls./Acre | - - - - - | | | 5,594. 2,838. |
| Average Percent Oil Recovery by Laboratory Flooding Tests | - - - - - | | | 3.5 |
| Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. | - - - - - | | | 50. |
| Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre | - - - - - | | | 298. |
| Total Calculated Oil Recovery, Bbls./Acre | - - - - - | | | 830. |
| Packer Setting, Feet | - - - - - | | | |
| Viscosity, Centipoises @ | - - - - - | | | |
| A. P. I. Gravity, degrees @ 60 °F | - - - - - | | | |
| Elevation, Feet | - - - - - | | | |

Fresh water mud was used as the circulating fluid while taking this core. The Kansas City core was sampled after being received in the laboratory while the Bartlesville core was sampled at the well site by a representative of Oilfield Research Laboratories. The well was drilled in non-virgin territory. Only the Bartlesville core will be considered in the following discussion.

FORMATION CORED

The detailed log of the formation cored is as follows:

| <u>Depth Interval,</u> <u>Feet</u> | <u>Description</u> |
|---------------------------------------|--------------------|
|---------------------------------------|--------------------|

KANSAS CITY LIME

| | |
|-----------------|----------------------------------|
| 1909.0 - 1914.5 | - Brownish gray limestone. |
| 1914.5 - 1930.0 | - Limestone (discarded at well). |
| 1930.0 - 1933.0 | - Brownish gray limestone. |
| 1933.0 - 1936.5 | - Limestone (discarded at well). |
| 1936.5 - 1945.5 | - Brownish gray limestone. |
| 1945.5 - 2038.0 | - Limestone (discarded at well). |
| 2038.0 - 2040.5 | - Brown and gray limestone. |
| 2040.5 - 2522.0 | - Drilled. |

BARTLESVILLE SAND

| | |
|-----------------|--|
| 2522.0 - 2524.0 | - Sandy shale. |
| 2524.0 - 2527.0 | - Shaly sandstone. |
| 2527.0 - 2533.0 | - Gray shaly sandstone. |
| 2533.0 - 2539.6 | - Grayish light brown, slightly shaly sandstone. |
| 2539.6 - 2544.5 | - Shale. |

Coring was started at a depth of 2527.0 feet in shaly sandstone and completed at 2544.5 feet in shale. For the most part, the pay is made up of grayish light brown, slightly shaly sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into two sec-

tions. The weighted average permeability of the upper and lower sections is 0.0 and 6.3 millidarcys respectively; the overall average being 6.3 (See Table III). By observing the data given on the core-graph, it is noticeable that the permeable sand has a rather regular permeability profile. The permeability of the sand varies from impermeable to a maximum of 11. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 23.4. The weighted average percent oil saturation of the upper and lower sections is 19.0 and 25.4 respectively. The weighted average percent water saturation of the upper and lower sections is 75.0 and 58.6 respectively; the overall average being 63.8 (See Table III). This gives an overall weighted average total fluid saturation of 87.2 percent.

The weighted average oil content of the upper and lower sections is 190 and 344 barrels per acre foot respectively; the overall average being 296. The total oil content, as shown by this core, is 2,838 barrels per acre of which 2,102 barrels are in the pay sand section (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 298 barrels of oil per acre was obtained from 6.0 feet of sand. The weighted average percent oil saturation was reduced from 25.3 to 21.8, or represents an average recovery of 3.5 percent. The weighted average effective permeability of the samples is 0.384 millidarcys, while the average initial fluid production pressure is 41.6 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 10 samples tested, 6 produced water and oil. This indicates that

approximately 60 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a fairly uniform effective permeability to water.

CONCLUSION

The results of the laboratory tests indicate that an efficient water-flood in the vicinity of this well should recover approximately 830 barrels of oil per acre or an average of 139 barrels per acre foot from the 6.0 feet of floodable pay sand analyzed in this core. These recovery values were calculated using the following data and assumptions:

| | |
|--|------|
| Original formation volume factor | 1.23 |
| Present formation volume factor | 1.11 |
| Reservoir water saturation, percent | 40.0 |
| Primary recovery, estimated, percent | 12.0 |
| Present oil saturation, percent | 42.1 |
| Average porosity, percent | 17.8 |
| Oil saturation after flooding, percent | 21.8 |
| Performance factor, percent | 55.0 |
| Net floodable pay sand, feet | 6.0 |

This core shows a pay sand section having a good oil saturation, a moderate water saturation and a fairly uniform effective permeability to water.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Bros. Lease _____ Crew _____ Well No. 16

| 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. | | |
| <u>KANSAS CITY LIMESTONE</u> | | | | | | | | | | | |
| 1 | 1909.5 | 5.2 | 27 | 50 | 77 | 109 | Imp. | 1.0 | 1.0 | 109 | 0.00 |
| 2 | 1910.5 | 12.1 | 5 | 41 | 46 | 47 | Imp. | 1.0 | 2.0 | 47 | 0.00 |
| 3 | 1911.4 | 7.7 | 25 | 67 | 92 | 149 | Imp. | 1.0 | 3.0 | 149 | 0.00 |
| 4 | 1912.4 | 6.3 | 35 | 59 | 94 | 171 | Imp. | 1.0 | 4.0 | 171 | 0.00 |
| 5 | 1913.6 | 7.0 | 25 | 43 | 68 | 136 | Imp. | 1.0 | 5.0 | 136 | 0.00 |
| 6 | 1914.4 | 5.7 | 43 | 53 | 96 | 190 | Imp. | 0.5 | 5.5 | 95 | 0.00 |
| 7 | 1930.8 | 13.5 | 39 | 36 | 75 | 408 | 0.48 | 1.0 | 6.5 | 408 | 0.48 |
| 8 | 1931.4 | 11.3 | 15 | 47 | 62 | 132 | Imp. | 1.0 | 7.5 | 132 | 0.00 |
| 9 | 1932.6 | 5.1 | 26 | 43 | 69 | 113 | Imp. | 1.0 | 8.5 | 113 | 0.00 |
| 10 | 1936.8 | 13.8 | 31 | 14 | 45 | 332 | 0.32 | 0.5 | 9.0 | 166 | 0.16 |
| 11 | 1937.6 | 6.6 | 26 | 46 | 72 | 133 | Imp. | 1.0 | 10.0 | 133 | 0.00 |
| 12 | 1938.3 | 12.8 | 11 | 45 | 56 | 109 | 2.1 | 1.0 | 11.0 | 109 | 2.10 |
| 13 | 1939.7 | 12.6 | 26 | 12 | 38 | 254 | Imp. | 1.0 | 12.0 | 254 | 0.00 |
| 14 | 1940.7 | 14.1 | 36 | 32 | 68 | 394 | Imp. | 1.0 | 13.0 | 394 | 0.00 |
| 15 | 1941.5 | 7.1 | 29 | 36 | 65 | 160 | Imp. | 1.0 | 14.0 | 160 | 0.00 |
| 16 | 1942.5 | 6.5 | 37 | 50 | 87 | 240 | Imp. | 1.0 | 15.0 | 240 | 0.00 |
| 17 | 1943.4 | 12.8 | 36 | 37 | 73 | 358 | Imp. | 1.0 | 16.0 | 358 | 0.00 |
| 18 | 1944.4 | 13.9 | 25 | 13 | 38 | 270 | Imp. | 1.5 | 17.5 | 405 | 0.00 |
| 19 | 2038.8 | 13.3 | 70 | 15 | 85 | 722 | Imp. | 1.2 | 18.7 | 866 | 0.00 |
| 20 | 2039.6 | 17.5 | 65 | 16 | 81 | 882 | 3.0 | 1.3 | 20.0 | 1,149 | 3.90 |

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Bros. Lease _____ Crew _____ Well No. 16

| 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. | | |
| <u>BARTLESVILLE SANDSTONE</u> | | | | | | | | | | | |
| 1 | 2527.8 | 14.3 | 13 | 81 | 94 | 144 | Imp. | 1.0 | 1.0 | 144 | 0.00 |
| 2 | 2529.6 | 13.2 | 21 | 72 | 93 | 215 | Imp. | 1.0 | 2.0 | 215 | 0.00 |
| 3 | 2531.2 | 11.8 | 23 | 72 | 95 | 210 | Imp. | 1.0 | 3.0 | 210 | 0.00 |
| 4 | 2533.1 | 16.1 | 26 | 63 | 89 | 325 | 1.4 | 0.6 | 3.6 | 195 | 0.84 |
| 5 | 2534.1 | 16.8 | 22 | 66 | 88 | 287 | 3.3 | 1.0 | 4.6 | 287 | 3.30 |
| 6 | 2535.1 | 17.3 | 25 | 64 | 89 | 336 | 3.6 | 1.0 | 5.6 | 336 | 3.60 |
| 7 | 2536.1 | 18.1 | 27 | 53 | 80 | 380 | 5.6 | 1.0 | 6.6 | 380 | 5.60 |
| 8 | 2537.1 | 17.8 | 25 | 56 | 81 | 346 | 8.8 | 1.0 | 7.6 | 346 | 8.80 |
| 9 | 2538.1 | 15.5 | 23 | 62 | 85 | 264 | 8.7 | 1.0 | 8.6 | 264 | 8.70 |
| 10 | 2539.1 | 19.8 | 30 | 48 | 78 | 461 | 11. | 1.0 | 9.6 | 461 | 11.00 |

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Jackson Bros. Lease Crew Well No. 16

| Depth Interval, Feet | Feet of Core Analyzed | Average Permeability, Millidarcys | Permeability Capacity Ft. x Md. |
|-------------------------|--------------------------|---|---------------------------------------|
| KANSAS CITY LIMESTONE | | | |
| 1909.0 - 1914.5 | 0.0 | 0.0 | 0.0 |
| 1930.0 - 1945.5 | 2.5 | 1.1 | 2.74 |
| 2038.0 - 2040.5 | 1.3 | 3.0 | 3.90 |
| 1909.0 - 2040.5 | 3.8 | 1.7 | 6.64 |

| Depth Interval, Feet | Feet of Core Analyzed | Average Percent Porosity | Average Percent Oil Saturation | Average Percent Water Saturation | Average Oil Content Bbl./A. Ft. | Total Oil Content Bbls./Acre |
|-------------------------|--------------------------|--------------------------------|--------------------------------------|--|---------------------------------------|------------------------------------|
| 1909.0 - 1914.5 | 5.5 | 7.5 | 25.2 | 52.1 | 129 | 707 |
| 1930.0 - 1945.5 | 12.0 | 10.9 | 27.8 | 34.2 | 239 | 2,872 |
| 2038.0 - 2040.5 | 2.5 | 15.6 | 67.5 | 15.5 | 806 | 2,015 |
| 1909.0 - 2040.5 | 20.0 | 10.5 | 32.1 | 36.8 | 280 | 5,594 |

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Bros. Lease Crew Well No. 16

| 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. |
|-------------------------------|-------------|----------------------------|-------------------------|--------------|--------------|--------------|---------------------|---------|--------------|-------------------------------|--------------------------------------|--|
| | | | % | Bbls./A. Ft. | % | Bbls./A. Ft. | % Oil | % Water | Bbls./A. Ft. | | | |
| <u>BARTLESVILLE SANDSTONE</u> | | | | | | | | | | | | |
| 1 | 2527.8 | 14.0 | 15 | 163 | 0 | 0 | 15 | 82 | 163 | 0 | Imp. | - |
| 2 | 2529.6 | 13.2 | 22 | 225 | 0 | 0 | 22 | 70 | 225 | 0 | Imp. | - |
| 3 | 2531.2 | 11.7 | 22 | 200 | 0 | 0 | 22 | 74 | 200 | 0 | Imp. | - |
| 4 | 2533.1 | 16.0 | 25 | 310 | 0 | 0 | 25 | 66 | 310 | 0 | Imp. | - |
| 5 | 2534.1 | 17.2 | 22 | 293 | 2 | 27 | 20 | 79 | 266 | 5 | 0.200 | 50 |
| 6 | 2535.1 | 17.5 | 25 | 339 | 3 | 41 | 22 | 76 | 298 | 6 | 0.200 | 50 |
| 7 | 2536.1 | 17.9 | 27 | 374 | 3 | 42 | 24 | 74 | 332 | 7 | 0.300 | 50 |
| 8 | 2537.1 | 18.3 | 25 | 355 | 4 | 57 | 21 | 75 | 298 | 20 | 0.500 | 30 |
| 9 | 2538.1 | 16.0 | 23 | 285 | 2 | 25 | 21 | 74 | 260 | 11 | 0.400 | 40 |
| 10 | 2539.1 | 19.6 | 30 | 456 | 7 | 106 | 23 | 73 | 350 | 24 | 0.700 | 30 |

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.

OILFIELD RESEARCH LABORATORIES

SOLUBILITY TESTS

TABLE VI

Company Jackson Bros. Lease Crew Well No. 16

| <u>Sample No.</u> | <u>Depth, Feet</u> | <u>Percent Solubility</u> |
|-------------------|------------------------|-------------------------------|
| 1 | 1909.5 | 88 |
| 2 | 1910.5 | 88 |
| 3 | 1911.4 | 84 |
| 4 | 1912.4 | 90 |
| 5 | 1913.6 | 79 |
| 6 | 1914.4 | 91 |
| 7 | 1930.8 | 85 |
| 8 | 1931.4 | 81 |
| 9 | 1932.6 | 81 |
| 10 | 1936.8 | 85 |
| 11 | 1937.6 | 88 |
| 12 | 1938.3 | 93 |
| 13 | 1939.7 | 88 |
| 14 | 1940.7 | 82 |
| 15 | 1941.5 | 89 |
| 16 | 1942.5 | 88 |
| 17 | 1943.4 | 88 |
| 18 | 1944.4 | 94 |
| 19 | 2038.8 | 89 |
| 20 | 2039.6 | 92 |

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

| | | | |
|---|-----------------|------------|--------------------|
| Company <u>Jackson Bros.</u> | Lease _____ | Crew _____ | Well No. <u>16</u> |
| Depth Interval, Feet | 2533.0 - 2539.6 | | |
| Feet of Core Analyzed | 6.0 | | |
| Average Percent Porosity | 17.8 | | |
| Average Percent Original Oil Saturation | 25.3 | | |
| Average Percent Oil Recovery | 3.5 | | |
| Average Percent Residual Oil Saturation | 21.8 | | |
| Average Percent Residual Water Saturation | 75.1 | | |
| Average Percent Total Residual Fluid Saturation | 96.9 | | |
| Average Original Oil Content, Bbls./A. Ft. | 351. | | |
| Average Oil Recovery, Bbls./A. Ft. | 50. | | |
| Average Residual Oil Content, Bbls./A. Ft. | 301. | | |
| Total Original Oil Content, Bbls./Acre | 2,102. | | |
| Total Oil Recovery, Bbls./Acre | 298. | | |
| Total Residual Oil Content, Bbls./Acre | 1,804. | | |
| Average Effective Permeability, Millidarcys | 0.384 | | |
| Average Initial Fluid Production Pressure, p.s.i. | 41.6 | | |

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



WELEX

INDUCTION-ELECTRIC LOG

COMPANY JACKSON BROTHERS
 WELL CREW # 16
 FIELD SALLYARDS
 County GREENWOOD State KANSAS

COMPANY JACKSON BROTHERS

WELL CREW # 16

FIELD SALLYARDS

COUNTY GREENWOOD STATE KANSAS

Location NE-NW-NE
 Sec. 34 Twp 25S Rge 8E
 Other Services: ACOUSTIC

Permanent Datum KELLY BUSHING Elev. 1514'
 Log Measured From KELLY BUSHING Ft. Above Perm. Datum
 Drilling Measured From KELLY BUSHING
 Elev.: K.B. 1514'
 D.F.
 G.I. 1509'

| | | | | |
|--|-------------------------------------|------|------|------|
| Date | 1-4-64 | | | |
| Run No. | ONE | | | |
| Depth-Driller | 2699' | | | |
| Depth-Welex | 2682' | | | |
| Btm. Log Inter. | 2677' | | | |
| Top Log Inter. | 90' | | | |
| Casing-Driller | 8-5/8 @ 90' | @ | @ | @ |
| Casing-Welex | | | | |
| Bit Size | 12 1/4" TO 90', 7-7/8" 90' TO 2699' | | | |
| Type Fluid in Hole | FRESH WATER MUD | | | |
| Dens. Visc. | 10 35 | | | |
| pH Fluid Loss | 13 ml | ml | ml | ml |
| Source of Sample | PIT | | | |
| R _m @ Meas. Temp. | 2 @ 58 °F | @ °F | @ °F | @ °F |
| R _{mt} @ Meas. Temp. | 1.52 @ 50 °F | @ °F | @ °F | @ °F |
| R _{mc} @ Meas. Temp. | 3.62 @ 42 °F | @ °F | @ °F | @ °F |
| Source R _{mt} R _{mc} | MEAS. | | | @ °F |
| R _{in} @ BHT | 1.19 @ 97 °F | @ °F | @ °F | @ °F |
| Time Since Circ. | 8 HOURS | | | |
| Max. Rec. Temp. | 97 °F @ 2699' | °F @ | °F @ | °F @ |
| Equip. Location | 4970 EL DORADO | | | |
| Recorded By | H. STEITZ | | | |
| Witnessed By | MR. JACKSON | | | |

