SHELL OIL COMPANY
OPERATOR
WILLS-FEDERAL AND PUBCO-STATE LEASES
APPLICATION FOR
WATERFLOOD PROJECT

JALMAT FIELD
LEA COUNTY, NEW MEXICO
APRIL 8, 1964

This exhibit is submitted in support of the application of Shell Oil Company to conduct waterflooding operations on the Wills-Federal and Pubco-State Leases in the Jalmat Field located in Sections 32 and 33, T-26-S, R-37-E, Lea County, New Mexico. This project would be an extension of present waterflooding operations in the Scarborough Field, Winkler County, Texas.

History

The Jalmat Field and the Scarborough Field produce from a common reservoir which underlies portions of Texas and New Mexico. The Jalmat Field denotes that segment of the reservoir in New Mexico and the Scarborough Field that part in Texas. The Scarborough Field was discovered in 1927 and produces from the Yates formation at an average depth of 3100 feet; however, the major development of this field occured in the late 1950's, subsequent to the development of fracturing techniques. The Wills-Federal and Pubco-State Leases were drilled in 1958 and 1959.

Waterflooding was started in the Scarborough Field in 1955 and currently most of the field is under waterflood or will be within the near future. Enclosure 1 is a map of the Jalmat and Scarborough Fields in the vicinity of the subject leases.

Geology

The Yates formation in the subject area has a gross thickness of about 400 feet and is composed of alternate layers of sandstone, dolomite, shale, and various combinations of the three. The carbonate sections are relatively uniform and dense and provide reliable correlative markers throughout the field. There are nine distinguishable sand zones (see Enclsoure 2) in the Scarborough Field. Sand development within each group varies considerably

even between adjacent wells; however, in general the deeper sand bodies near the center of the field exhibit better continuity. In the norther part of the field, in the area of the planned waterflood expansion, the deeper sands are not as well developed; whereas, sandstones in the upper part of the Yates section show improved reservoir characteristics. The upper sands are not as widespread as the deeper sands and their erratic occurence suggests the influence of stream channel deposition. However, these upper sands do possess high average porosities and appear to be excellent waterflood prospects.

Reservoir Data

The primary producing mechanism of the Scarborough and the subject portion of the Jalmat Field has been solution gas drive. Due to the low permeability of the Yates sands, the production rate has declined rapidly resulting in poor primary recovery efficiencies for these fields. A tabulation of the average reservoir parameters, oil data and general reservoir data is presented by Enclosure 3. The values for initial oil saturation and residual oil saturation after waterflooding were derived from general correlations of core data as cores were not available from the wells in the waterflood expansion area.

Current Status

Both the Pubco-State and Wills-Federal Leases are in the stripper stage of depletion as a result of the rapid decline of the production rates from the maximum achieved shortly after development in 1958 (see Enclosures 4 and 5). Currently the oil production averages about three barrels per well per day for the Wills-Federal Lease and one barrel per well per day for the Pubco-State Lease.

Waterflood Expansion

A 5-spot pattern is employed throughout most of the Scarborough Field; however, due to the irregular spacing of existing wells and the odd shapes of the leases, an irregular pattern will be employed in this expansion. The injectors were selected such that injection could be balanced across lease lines and the state line, which would protect the correlative rights of all parties affected. All of the injectors are completed with casing cemented through the Yates formation, with perforations in one or more of the sand zones. The details of the completions are presented in Enclosures 6, 7, 8, and 9.

The waterflood currently in operation in the Scarborough Field indicates that the water injection rate for this expansion will be about 100 barrels of water per day per injector. This is the injection rate proposed for the waterflood in Sections 32 and 33 and is commensurate with the adjacent waterflood across the state line in Texas. A map of the water distribution system, with the injection rate noted, is presented in Enclosure 11.

The Santa Rosa formation is the source of the water for the proposed waterflood expansion. Santa Rosa water is relative fresh and had proved to be an excellent source of water for waterfloods. An analysis of the Santa Rosa water is presented in Enclosure 13. The water source well water (see Enclosures 11 and 12) is located in Section 2, Block C-23, PSL Survey, Winkler County, Texas. Water will be imported into New Mexico through the water distribution system in Enclosure 11.

Predicted Waterflood Performance

Waterflooding has proved to be a very successful method of operation for the Scarborough Field, with recoveries near the center of the field expected

to exceed 15,000 barrels per acre. Secondary recoveries become progressively poorer to the north and are expected to average between 2,000 and 5,140 barrels per acre in the area of the planned waterflood expansion. The predicted performances presented in Enclosures 4 and 5 indicate that the proposed waterflood will recover an additional 800,000 barrels of oil from the two leases. Almost all of this additional oil can be considered secondary oil, due to the low current productive capacity of the wells.

I. Reservoir and Fluid Data - Jalmat Field and Scarborough Field.

A. Information on entire reservoir

1. Name of formation: Yates
2. Estimated productive area of entire reservoir: 10,840 acres
3. Composition (sand, limestone, dolomite, etc.): Sand
4. Type of structure: Anticline
5. Subsea depth of oil-water contact: None Gas-oil contact: None
6. Type drive during primary production: Solution Gas Drive
7. Original BHP: 1500 psi (approx) Current BHP: 50 psi
8. Saturation pressure: 500 psi (est.) Formation Volume Factor: 1.1 (at present)

B. Information on proposed project area

1. Number of productive acres in leases within project area: 440
2. Average depth to top of pay: 3050 feet
3. Average effective pay thickness (feet): 50
4. Average porosity (%):17
5. Average horizontal permeability (mds.): 15 Range: 0-22
6. Connate water content (% of pore space): 45
7. Gravity of oil (API):36 degrees Viscosity: 2 cp.

II. Primary Production history

1. Date first well completed on leases: January 1958
2. Stage of depletion of project area: Primary 95% depleted
3. Number of producing wells in project area: 9
4. Average daily oil production per well at present time: 2 B/D
5. Average gas-oil ratio: 6500 ft^3/bbl Water production (%): 40%

III. Results expected

1. Estimated oil saturation at present time (% of pore space): 50%
2. Estimated residual oil saturation at abandonment: 40% (average)
3. Estimated ultimate additional oil that will be recovered as a direct result of injection (bbls.): 800,000

IV. Injection

1. Type of Injection Fluid (water, gas, LPG): Water
2. Source of injected fluid (formation, depths): Santa Rosa Formation (550')
3. Injection pattern and spacing: Irregular
4. Maximum injection pressure to be used (psi): 1600 psi.
5. Estimated maximum per well rate of injection (bbls.): 100 B/D

Enclosure 3